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UNIFORM SYSTEM OF ACCOUNTS IN NEW YORK.

The Public Service Commissions law of New York State gives the commissions power to prescribe uniform methods of keeping accounts, records and books to be observed by the persons, corporations and municipalities engaged in the manufacture, sale and distribution of gas and electricity for light, heat or power. In pursuance of this authority the commission of the Second District promulgated a tentative scheme of accounts in April inviting criticisms. After such criticism had been secured, a revised classification of accounts was prepared and submitted by the commissions of both districts at a joint hearing in New York City on June 24. At this hearing representatives of a number of companies made general or detailed criticisms of the scheme, and the hearing was adjourned without any definite announcement regarding the final action to be taken by the public service regulating bodies. It is therefore a consistent assumption that the scheme is still in tentative form and that the commissions continue to be in a receptive attitude with respect to classifications the utility of which may be questionable. If the fundamental motive of the members of the commission is to prescribe a system of accounts that is designed to assure justice to the corporations as well as the public, the companies should co-operate as much as possible in the preparation of the classification; if the suspicion should be excited that the commissions propose to establish a scheme of accounting that would infringe on the rights of the corporations, grave reasons would impel public protests on the part of accounting and executive officers against any action which might result in distress to their properties. There should consequently be a unanimous desire on the part of all the companies interested to express their opinion regarding the system before the time shall have passed when their wishes can be considered.

The commission of the Second District favors publicity, and its statistician, Mr. W. J. Meyers, has informed us that he is authorized by the chairman to say that the commission "is heartily in favor of having as broad a discussion as is practicable, in order that any defects contained may be foreseen and provided for before the system is put in operation. It is recognized that the discussion of these matters through your publication will do much to facilitate the detection of defects, and for that reason we heartily approve of your proposition to discuss the matter through your columns and to publish letters from your contributors relative to the proposed accounts." In accordance with the favorable opinion thus expressed regarding the publication of letters of this character, we print in this issue extracts from criticisms made by Mr. F. L. Dame, and we desire to give publicity to other discussions on the same subject. It should be recognized that this space is devoted to the purpose because of a recognition of the important fact that any uniform system of accounts prescribed by a commission of this character has in mind to some extent the exercise of state

control over the disposition of earnings, and the application of expenditures. If companies do not respond to the efforts of the commission to secure criticisms of tentative accounts, the commission is justified in assuming that the proposed classification is acceptable to the corporations. It is possible that the officials of some companies may not attend hearings because of a feeling that the expense of a trip is not justified by the earnings of the property, but criticisms need not be withheld entirely on this account; they can be made through letters. The commission cannot be expected to know the attitude of the practical officials of the companies unless their position is set forth fully and frankly.

A Policy That Wears Well.

During the discussion of the relations of the central station and the contractor at the National Electrical Contractors' convention at Chicago, in July, Mr. Alex Dow, of Detroit, gave some good advice both to central stations and contractors as to the kind of advice to give to present and prospective customers. In the large cities the most likely cause of friction between central stations and contractors is the installation of isolated plants by contractors. It is supposed to be human nature for contractors to encourage the establishment of isolated plants because of the profit connected therewith. On the other hand, the central station is supposed to oppose the installation of isolated plants at all times, in season and out of season. It was therefore refreshing to hear Mr. Dow come out squarely and say that it was the practice of the central station company at Detroit to advise customers to put in an isolated plant, or even gas lighting, if that were the thing that was really best suited to their needs. He preferred if central station service were not the best thing for the customer, to have said customer find that fact out from the company rather than by sad experience. Mr. Dow pointed out that it is in the long run equally to the advantage of the contractor to tell the customer the truth in all cases. Dissatisfied customers are bad assets for any kind of a concern.

The Size and Power Factor of Motors.

Attention has frequently been called in convention discussions recently to an error that is likely to be made whenever an electric motor of either the single-phase or polyphase induction type is installed to replace a gasoline or steam engine. We refer to the general tendency to put in a motor too large for the work. To be sure it is well to put in a motor large enough to provide for the growth of a year or two, but leaving aside this consideration the general tendency is to overrate the immediate demands which will be made on a motor. For example, a gasoline or a steam engine in poor condition after several years of service may have trouble in pulling a load which temporarily goes above its rated capacity. When an electric motor is put in to do the same work, inexperienced persons will usually select a motor of larger capacity than the engine, reasoning that the power required must be more than the rated horse-power of the engine. They fail to remember that the motor can stand temporary overloads very well and that it is far better to overload a motor for a few seconds or a few moments at intervals than to put in an induction motor which is too large for the work and which consequently runs most of the time at a very low power factor. This low power factor means that larger transformers, lines and generators must be used than are really necessary. It also means that whenever the motor is started, a greater disturbance of the voltage will occur. The only one to gain by putting in too large a motor is the man who sells it, and even this gain is questionable because sometimes the prospective customer will be scared away by the high price of the motor which is thought to be necessary for his work. In the long run, it is to the interest of central-station companies, dealers and manufacturers to see that this common mistake is prevented.

Recent Progress in Submarine Telephone Cables.

As recently noted in our Digest columns, some particulars of submarine telephone cables, lately manufactured in Germany, have been published in the *Elektrotechnische Zeitschrift*. The latest cable of this type connects Germany and Denmark, Fehmarn and Lolland. Its length is 12 miles, 19.32 km, or 10.5 knots. This is not a serious telephonic cable length in itself, but becomes considerable when included in a much longer telephone circuit. The cable is insulated with paper and air-space, which is an unusual type of insulation for submarine cables. Its conductor is also compound, being formed of a copper central group overwound with three layers of fine soft iron wires. It would seem that the iron contributes but little to the conductivity of the conductor, and is applied mainly for the purpose of increasing the inductance. Over the compound conductor is a loose wrapping of dry paper, followed by a paper cover. Four such cores are wound up, side by side, and enclosed in a paper tube, which is covered with two waterproof seamless lead coatings. At intervals of 150 m there are watertight seals over the entire cross-section 1 m long to prevent the infiltration of sea water to great distances, in case of injury to the leaden sheath. Special forms of iron wire are applied, as external mechanical protection, to the lead-covered cable, with the usual allowance of jute and bituminous compound.

The amount of inductance which can be inserted in a cable by overlaying its conductor with iron wire is comparatively small, because the magnetic force at the surface of the conductor is necessarily so feeble with telephonic currents. A much greater added inductance can naturally be provided with loading coils introduced at intervals. At the present time, however, it is not practicable to connect load coils in a deep-sea cable at the necessary short intervals, and there is this to be said for the iron wire covering of the copper, that such inductance as it provides is distributed smoothly throughout the cable, and that consequently there can be no reflection losses due to lumpiness of loading. Although it is possible to lay lead-sheathed cables with paper and air insulation in shallow water along the shore, it would not be practicable to lay such cables in deep water, because, aside from the question of deforming stresses in the laying of deep-sea cables, the pressure of the superincumbent water would crush them and no free internal air can be allowed in them. The water pressure in deep oceans amounts to several tons per square inch. Up to the present time only the resins, rubber and gutta-percha have been found capable of withstanding such pressures indefinitely, as dielectrics.

The article points out that serious dielectric losses occur with gutta-percha insulation; that is, losses which accompany alter-

nating voltage resembling dielectric hysteresis, and producing the equivalent effect of leakage. In cables insulated with paper and air, this dielectric loss appears to be much smaller. The question is raised whether it is feasible to construct telephone cables of gutta-percha for long distance service, even when loaded with coils at suitable intervals, owing to the serious effects of dielectric loss. It seems likely that for distances in excess of 100 miles, electric telephony will have to be carried wirelessly over the sea, instead of by conductors under the sea. One would naturally suppose that since telephonic currents are feeble currents, that the wireless method, which requires considerable power, and scatters this power to all points of the compass, could not compete with the insulated conductor method, using submarine cables, which are capable of operating distant apparatus with only a very small expenditure of power. Nevertheless, the great distortion of telephonic sound, due to the selective action of capacity, the difficulty of inserting load coils in cables, and the dielectric losses in the gum insulators, turn the advantage the other way and make ultimate ocean telephony more probable by wireless methods.

THE VOLTAGE RATIO OF CONVERTERS.

It is well known that the synchronous converter, for supplying energy to direct-current distributing systems from alternating-current transmission lines, resembles the dynamotor in regard to voltage regulation. The dynamotor is a direct-current machine having two separate windings on the same armature core, each connected to a separate commutator. One winding is, say, for 220 volts, and the other, with one-tenth as many turns, for 22 volts. The first may be connected to 220-volt direct-current mains, as a motor winding; while the second may be used as a low-voltage generator winding. It is well known that although we may alter the speed at which the dynamotor runs by altering its field excitation, we cannot thereby alter the secondary commutator voltage, which will remain stationary at 22 volts, subject, however, to drop of potential under load. In the same way, a converter which takes three-phase currents into its armature at 370 volts between collector rings, will deliver about 600 volts to a direct-current railway system between commutator brushes. Being a synchronous machine, we cannot change its speed of rotation. Moreover, if we alter the field excitation, we do not materially alter the commutator voltage, we only change the phase of the incoming alternating currents, or the power-factor of the machine. When the load comes on the railway system, the voltage at the commutator brushes tends to fall slightly, owing to drop of potential in the windings, if the voltage between collector rings is maintained constant. There is no way of coaxing the ordinary converter to raise its commutator voltage, except by raising its collector-ring voltage. Herein lies the analogy to the dynamotor case.

Two devices are used for raising the voltage supplied to the converter when the load comes on. One device is automatic, the other non-automatic. The automatic device employs reactances in the supply circuit, usually between the transformer secondary terminals and the converter slip-rings. A series winding is also applied to the field magnets on the direct-current side. As load comes on, the excitation will increase owing to the action of the series windings, and the machine will take leading currents from the supply mains, in the manner of an over-excited synchronous motor. The leading currents, passing through reactances, raise the voltage automatically, so that the voltage at the collector-rings will raise with the load. The non-automatic scheme for raising the collector-ring voltage with load consists in changing the transformation ratio of the transformers supplying energy to the converter, using taps and switches for this purpose. The automatic reactance device is undesirable on account of insufficiency, when large ranges of commutator voltage variation is required. The non-automatic device is sometimes objected to on account of the space it occupies.

In Germany, a favorite device is a booster synchronous machine on the same shaft as the converter, and connected only in the collector-ring side, with separately excited field magnets. By varying or reversing the excitation of the booster, the collector-ring voltage left at the taps of the convertor winding may be raised or lowered through a suitable range. More recently, it has been proposed to split all the field-magnet poles of the converter into symmetrical components, each component having a separate exciting winding. Two such types of split-pole converters have been tried, one with each pole divided into three parts, and the other with each pole divided into two parts. With the three-part type, each pole has a middle part and two outer parts. When it is desired to raise the commutator voltage, the excitation of the outers is raised to assist that of the middle section. When it is desired to lower the commutator voltage, the excitation of the outers is first lowered, and then, if necessary, reversed. In the two-part type of field pole, one part of each pole is excited steadily and the other part has its excitation either raised, lowered or reversed.

The theory of action in case of either the two-part or the three-part pole is that the e.m.f. on the collector-ring side depends upon the square root of the average square of the generated voltage, as developed in any cycle; whereas the e.m.f. on the commutator side depends only on the average generated voltage. By altering the magnetic flux through the component parts of the field-magnets, the alternating voltage, or root of mean square, may be kept substantially constant, and yet the direct average voltage may be altered considerably to suit the requirements of distribution. In other words, the split-pole converter works by altering the form-factor of the generated e.m.f. The papers read by Prof. C. A. Adams and Mr. J. L. Woodbridge at the Atlantic City A. I. E. E. convention, which was held June 29, July 1 and 2 last, deal with the analysis of this intricate subject. It might be supposed, at first sight, that there would be less electrical disturbance in the system with three-part poles than with two-part poles; because in the three-part pole, neglecting armature reactions, the magnetic distribution will always be symmetrical with respect to the pole center; whereas with the two-part pole, there must be a large movement of the magnetic center of the pole when the auxiliary component of the pole is reversed. It appears, however, from the reasoning presented in the paper, that this is not the case; on the contrary, the alternating current ripples may be much less prominent with the two-part pole magnetic dissymmetry, than with three-part pole magnetic symmetry. Consequently, since the two-part pole machine has fewer parts and windings in the field-frame, the advantage lies wholly in favor of the two-part pole machine.

Important Patent Decision.

The U. S. Supreme Court has rendered a decision in a patent case, according to which the owner of a patent does not forfeit any rights under the same by withholding its use from the public. The case was that of the Eastern Paper Bag Company, which had sued for infringement of a patent of which it had not made use and had denied use to others. Among the arguments offered by the defense were that for an owner to neglect to use a patented invention and yet restrain others from using it was to violate the intent of the patent monopoly, the purpose of which is to promote the progress of the useful arts. The court, relying upon precedents, rejected this view, and held that the granting of a patent monopoly implies that the owner has an absolute property right in a patent.

According to this decision if an owner does not wish, for any reason, to work a patent, he need not do so, and can restrain all others from doing so during the life of the patent. In a dissenting opinion, Justice Harlan held that the prevailing opinion of the court was in conflict with public policy.

American Association of Electric Motor Manufacturers.

A meeting of the leading electric motor manufacturers of the United States was held at Hot Springs, Va., during the first week in June, as a result of which the American Association of Electric Motor Manufacturers has been formed to promote closer business and social fellowship; to improve engineering and commercial practices relative to motors; to collect and disseminate statistics and information, and to promote the industry in every lawful way.

The membership of the association consists of three classes: A, which includes manufacturers of direct-current motors up to and including 50 hp; B, manufacturers of alternating-current motors up to and including 50 hp; C, manufacturers of direct or alternating-current motors or both above 50 hp.

Each member company is entitled, in addition to its voting representative, to two associate representatives for each class. Only voting representatives can hold office, but associates may serve on any committee except the executive. Under the constitution which has been adopted the following officers have been elected: President, S. L. Nicholson, Westinghouse Company; vice-president, Class A, C. F. McGilvray, Robbins & Meyers Company; vice-president, Class B, R. J. Russell, Century Electric Company; vice-president, Class C, F. S. Hunting, Fort Wayne Electric Works; temporary secretary, J. C. McQuiston, Westinghouse Company. The executive committee comprises Messrs. C. W. Holtzer, C. H. Roth, B. C. Kenyon, J. C. Hobart, James Burke, W. A. Layman, J. W. Ham, A. H. Whiteside and A. L. Doremus.

A constitution comprising 13 articles has been adopted, as well as a set of by-laws. It is provided that the committee of classes A, B and C shall deal with matters relative to the ratings, guarantees and trade conditions in connection with motors in the classes for which they are appointed, and with the collection and dissemination of data of interest to each class.

At the Hot Springs meeting it was stated that companies with a capital of approximately $200,000,000 were represented and that the action was due to work of the organization committee appointed earlier in the year. It was believed that unreasonable conditions imposed by legislatures, railroads, fire underwriters and others could be obviated or withstood by the work of such an organization, in which the manufacturers could work as a unit for the betterment of their condition. At the Hot Springs meeting 25 companies were actually represented with 31 representatives, and it is understood that several other companies have since given in their adhesion as members.

The annual meeting of the association is to be held in May of each year, when papers and discussions will be considered, but a call has been issued for a meeting to be held for three days, beginning Monday, Sept. 7, at the Thousand Islands. The association has already done a good deal of active work in the line of organization and has taken offices in the Engineering Building, New York. At the September meeting committees will report on such subjects as advertising, publicity and expositions, cost accounting, commercial and engineering practices, freight, insurance inspection and regulation, other manufacturers' associations and central station associations. These committees are separate and distinct from the regular and standing committees of the body, which are also expected to report at that time.

Boston Edison Business Increasing.

The Edison Electric Illuminating Company, of Boston, has made public the following statement of business installed, discontinued and net new business by months in 16-cp lamp equivalents for the past fiscal year:

	Installed.		Discontinued.		Net new business.	
	1907-8.	Increase.	1907-8.	Increase.	1907-8.	Increase.
July	36,407	16,653	7,340	*11,993	29,067	28,646
August	29,648	15,988	9,883	2,117	19,765	13,871
September	29,569	6,771	20,591	11,046	8,978	*4,275
October	40,764	13,357	7,770	1,723	32,904	11,634
November	25,346	1,841	12,494	1,776	12,852	65
December	21,599	*4,029	11,260	487	10,339	*4,516
January	26,621	2,812	26,368	14,425	253	*11,613
February	14,654	*3,255	10,336	52	4,318	*3,307
March	18,765	*5,666	11,548	51	7,217	*5,717
April	21,748	*3,570	15,849	7,377	5,899	*10,947
May	13,702	*8,842	11,973	4,315	1,729	*13,157
June	13,726	*6,466	12,071	1,721	1,655	*8,187
Totals	292,549	25,594	157,483	33,097	135,066	*7,503

*Decrease.

The business installed in the year increased 19.45 per cent, compared with an increase of 19.6 per cent the previous year. The business discontinued showed an increase of 10.47 per cent, compared with 9.1 per cent the previous year, the net new business increasing 8.98 per cent, compared with 10.5 per cent in the previous year.

The company's total 16-cp equivalents connected on June 30, 1908, were 1,638,544, compared with 1,503,478 a year ago, and 1,306,909 two years ago. Lamps and motor connections on June 30 for the past four years are as follows:

	1908.	1907.	1906.	1905.
Incandescent lamps	938,679	863,213	788,560	708,384
Arc lamps	9,867	10,339	10,543	10,102
Motor horse-power	39,422	35,095	30,432	26,432

Some Notes from Europe.

By Dr. Louis Bell.

Budapest is really an interesting and beautiful city, with a flavor distinctly Eastern in the babel of tongues and the cosmopolitan air of the crowd. Electrically it is somewhat wide-awake, with M. de Fodor and his confrères to keep things moving, and the famous firm of Ganz to hold up the manufacturing and engineering end of the line. M. de Fodor was in Paris, so I could not congratulate him as I would have liked on the admirable results of his activity. I was especially interested in finding in his new station, now building, a battery of the big boiler units I mentioned in a previous article. Babcock & Wilcox these were, nearly double the size of those commonly used with us—the biggest that firm ever turned out. As to street lighting, Budapest has few arcs, but lots of Auer burners, for the city has a jiu-jitsu grip on the gas company that makes a lead-pipe cinch look like a granny knot. The new metallic-filament lamps are much in evidence in private lighting, about 30,000 now being in use. Just has a factory in town. Dr. Blathy I was fortunate enough to find, and owe to his courtesy and that of his Italian confrères an admirable opportunity to overhaul the Valtellina line. Interior lighting is, as a whole, rather glaring than good in Budapest, as commonly on the Continent, but I found one very beautiful exception in the main government telegraph plant in Budapest, the engineer of which is singularly skilful and alert. It is really a beautiful plant, with the latest ideas in all the apparatus and admirably lighted with arcs

under concentric diffusers—42 of them—at 12 amp each. By day the room is splendidly lighted from the sides and ventilated by a big monitor roof, with a water spray playing on it for coolness in summer. And, by the way, the postal collections are made with motor-tricycles in Buda and have been for several years past.

I left Budapest Tuesday and made back tracks to Vienna, and then started for the long pull to Venice the next morning. The scenery, as all travelers know, is fine, in many places singularly magnificent. It was nearly 11 when I struck water-logged old Venice and was dumped into a sort of aquatic hearse and paddled to my hotel through what seemed in the darkness like endless sewer pipes, the gondolier howling like a dervish whenever he approached a corner. Confidentially, what Venice really needs is electric street lights and an active street cleaning department. Of course, by morning Venice was Venice, but at night I'll venture to say it was as well lighted a hundred years ago. There is a municipal gas works and electric-light plant. I fancy it has to be municipal, for the apparent patronage would hardly keep a private concern in postage stamps and lubricants. By careful searching I found some metal-filament lamps and a few flame arcs, put there doubtless to attract the English and American moths that flutter around St. Mark's. It takes a goodly bunch of our countrymen (and women) to keep the antiquity factories going, but they were there in force and the makers of fourteenth century novelties will have a good season.

Friday morning I came away, rather regretfully withal, for one could fall very easily into the Venetian pace, and came up across the plains to Milan. Just before entering the city we passed under one of Semenza's admirable pole lines. It looks exceedingly businesslike and our American engineers would do well to study it a bit in the interest of economical construction. Of Milan one need only say that in spite of its ancient history and glorious relics of the past it seems exceedingly wide awake—fine cab system, electric cars humming everywhere and admirable lighting. By the way, there are a few of the most tremendous double-decked cars here that I have ever seen—enormous—with gigantic trailers. The ensemble strongly suggests moving houses at a twentieth-century pace. Milan is the only Continental city I have seen where they have series-arc lighting in anything like the American sense—with American types of machinery, moreover. And American electric fans in the hotels. They are needed at this temperature. There are signs of a sense of propriety in diffusing shades, and quite a good many metallic filaments among the incandescents, too, of various European makes. But I have found another holiday here—due on Monday—I believe St. Peter and St. Paul are the favored parties, so after a run up the Valtellina line I am going to strike out for Geneva and spend the holiday traveling.

The next three days have been, electrically speaking, as well as otherwise, of great interest. Starting out from Milan one follows for miles the transmission lines that have made northern Italy conspicuous. The constructions are interesting more especially from the very general use of steel lattice poles. Poles they are, not towers, spaced not more than 40 to 50 m, I should think. There are square lattice poles, some with wooden extension tops, some with steel throughout and wooden cross-arms, some all steel. I noted in particular a very workmanlike slender latticed A-pole bearing only the three-line wires and set in concrete, like most of the poles. The A was set in general with its base in the line of the wires, but every few spans and at angles, poles were crosswise the line to give lateral stability. At road crossings a simple cage was stretched under the lines, and at railway crossings a more elaborate one. Some lines carried six wires, one circuit being above the other. Wooden poles are used to some extent, but the more flexible lattice seems to be the standard of construction. The route I followed is the familiar one up along by Lake Maggiore with the high mountain rising behind it, and then steadily up the valley toward the Simplon. Nearing the Simplon there are several long and vile preliminary tunnels made almost intolerable by the heat and smoke, but at Isolla one of Brown's beautiful big three-phase locomotives slid gently into place at the head of the long train and there was something doing. What the Simplon tunnel would have been without electric traction can hardly be imagined—it must have pretty nearly passed the limits of human endurance. As it is, the heat deep in on the Italian side is something Tophetic. You remember they struck hot springs in there in boring the tunnel. On the Swiss side, the temperature suddenly changes for the better. But the big locomotive took us through in short order, and at Bries uncoupled for return service. No one who has ever been through the Simplon and seen these machines in actual service will ever have any doubts as to the practicability of three-phase traction in large work.

At Viege I dropped off and took the narrow-gage rack road to Zermatt—a thing of ferocious grades—mostly some 20 per cent when the real climbing began. A little above Viege they are building a large power station, not yet near completion, with a big hydraulic head to judge from the immense upward sweep of the way cleared for the pipe lines. The Viege is a wild stream hardly held in place by its rock walls and masonry embankments and will ere long prove a splendid source of power. Next day another demonstration of the three-phase theorem came in the Gornergrat rack road rising by breakneck grades and narrow winding rock ledges 1500 m above Zermatt to what is probably the wildest panorama this side of the Himalayas. The electric locomotive did its duty beautifully and the collectors seemed to work to perfection. The double trolley, worked with bows as it is, appears to be an entirely simple and practical thing in actual operation, whatever theoretical objections one may raise against it. To-day I came down from Zermatt and rode down the Rhone Valley to Martigny, a beautiful and interesting country, rich in power. One would over and over see from the train a pole line with the three tell-tale insulators, and follow it far across the valley until it dodged into the mouth of a canyon with perhaps a glimpse of the roof of the power station or the last steep plunge of the pipe line. The poles used along here are with few exceptions wooden, generally with the porcelain insulators set on the simple steel hook fixtures so familiar in Continental telegraph practice.

At Martigny I transferred to a narrow-gage electric line for Châtelard—bow trolley in the town and third-rail when the line got away and settled down to the climbing. Save for some tremendous grades in the earlier part of the run this mountain road is worked without racks, and I assure you it does some stiff climbing on adhesion alone. It was rather reassuring to note the presence of track brakes that looked fit to pull up the rails before they would slip. The road is a beautiful piece of engineering along the rim of the valley with walls dropping sheer down below one in places 1000 ft. or more. At Châtelard I found out that instead of going by diligence to Argentiere, the electric line was opened through to Chamouni this very day and I was on the first regular train. At a station a bit beyond Châtelard there was a change to the cars of the new line and down we came, passing through a very long tunnel under the mountains on which they have been pegging away for two or three years. Then down the valley a faster pace to the station at Argentiere, and after a short wait, down to Chamouni. The new line cuts down the time from Martigny to Chamouni to about three hours and a half and should turn a good bit of travel down this way. This evening Chamouni has been celebrating the opening of the road—red fire, cannon crackers and pyrotechnics generally. Also a procession of the Chamouni volunteer fire brigade in uniform and brass helmets, bearing Chinese umbrellas with lighted lanterns pendant from the ribs and headed by the local brass band and bearers of torches. The whole town was out, and I assure you they did it up in style. They have arc and incandescent street lights here—even flame arcs in front of shops. The whole region is full of water powers rushing down from the high Alps, and it will not be long before hardly a village will lack electric light and power. In fact, the time is pretty near already.

Until I reached Strasburg day before yesterday I had practically not been out of sight of a power transmission line for a

week. Switzerland seems to be fairly enmeshed with them. Structurally the Swiss line reminds one on the average of some of the earlier American lines. It is designed after the manner of a Continental telegraph line. Cross-arms are rare, the insulators being usually carried on hook-shaped steel bolts like telegraph insulators, but considerably higher. The bolts often pass through the pole with a firm bearing plate on either side, making a very solid and practical construction for moderate voltages. The spacing obtained in this way is not over 2 ft. between centers, but this, again, is quite sufficient for the usual voltages. The insulators are, as usual, porcelain, mostly double petticoated, now and then triple. The poles are 35 ft. to 40 ft., but generally very slender. They look hardly more than 5 in. at the top and 8 in. or 9 in. at the base, and are sometimes even slenderer. The top is capped with a little low metal cone by way of roof. Poles of the kind mentioned are spaced closely, say, 100 ft. or a little less, and carry three or six wires. At crossings of roads there are lattice steel poles with a grounded metal frame surrounding the wires, and sometimes a wire cradle under the line. The Swiss plants, you see, have cheap line construction and as the hydraulic heads are generally considerable, they are, on the whole, of moderate first cost and, as a rule, have paid, sometimes very little at first, but steadily more and more as time goes on. They get good prices for light and power—quite as good as we do.

Last Sunday I spent in Interlaken and took a run up the so-called Jungfrau Railway. It really does not reach the Jungfrau at all, much less ascend it, and very possibly it never will as construction will depend on returns from the present line. It is, nevertheless, a remarkably nervy piece of construction and the 300-hp, three-phase motor cars perform admirably. At present the electric line is only a few kilometers in length beginning at Scheidegg, to which one is brought by a steam rack railroad with ferocious grades, but not more than a third of its length is in the open, the latter part of the run being entirely in a tunnel cut through solid mountain, with one look-off station cut in the rock and a terminal station with a lookout and restaurant, also in a space blasted out of solid ledge. The view is reputed magnificent, but Sunday it was equal parts snowstorm and clouds. The chief power station with transmission at 7000 volts is at Lauterbrunnen, but a new and bigger station is just being finished on another stream a little nearer Interlaken. A couple of days previously I had visited the very fine municipal station at Geneva—about 20,000 kw in 15 big vertical-shaft units with two-stage turbines to take care of the variable head —about 6 m to 8 m only. It is an admirable plant, but they kick in Geneva at the prices charged, intimating that it is a municipal plant and can charge what it pleases. It pays, in fact, a handsome profit (on the books at least). Municipal ownership advocates, take notice of the kick.

I am continually impressed by the weird interior wiring that I see. It is enough to make the Board of Underwriters have the cold shivers, if not heart failure. If one were to formulate the wiring rules from inspection they would run somewhat as follows: 1. The use of rubber-covered wire is strongly forbidden. 2. Interior conduit, if used, must begin at least 0.5 m from all switches and cut-outs and must be carried in contact with walls or ceiling. 3. The leads thus installed must be separated from each other by no more than 5 mm, etc., etc. List of approved fittings: Twisted Underwriters' wire; lamp cord, if not too large; double-headed steel tacks; metal-covered snap switches (if run warm), etc., etc. Positively much of it is fairly unthinkable when buildings already constructed are wired. As to new buildings I cannot say, but there is evident need for active wire inspection in many places. On the other hand, I think the people are more cautious than with us about the running of high-voltage wires. Of course, one common source of high-voltage circuits is here averted from the fact that practically everywhere arc lamps are run on the multiple system at very moderate voltage. But transmission circuits are quite generally plainly marked and there is caution everywhere. The metal-filament lamps are much in evidence all around. It is very hard to get any idea of the actual proportion in use, as customers put on what lamps they want, but it is evident that there is rapid progress—helped along by the large number of makes available at rather moderate prices. The tungsten lamp is in at least half a dozen makes and of all sizes from 20 cp up

A Criticism of the Proposed Accounting System for New York Electric Lighting Corporations.

Responding to requests from the Public Service Commissions of New York for criticisms of the tentative classification of accounts for electric-lighting companies, Mr. F. L. Dame, engineer of the Electrical Securities Corporation, has discussed the proposed accounts in letters which are available for publication in the Electrical World by permission of the statisticians of the two commissions.

Mr. Dame submitted the operating classification used by the Geneva-Seneca Electric Company, which, he said, "is satisfactory and well adapted for the use of this company, with annual gross receipts of some $63,000." Mr. Dame added: "This form is the one in general used by Stone & Webster, J. G. White & Company and many other able operating concerns, as well as by a great majority of the smaller companies throughout the United States at present having adequate systems of accounting. This form is substantially the one adopted by the National Electric Light Association in 1900, and as a member of the 1908 National Electric Light Association committee on uniform accounting I desire to say that the small companies, so far as I know, strongly prefer this classification to that adopted at the Chicago convention this year."

As it is proposed to adopt a uniform classification for New York companies which will be adaptable to the needs of both large and small companies, Mr. Dame submitted a classification of operating accounts which provides for the subdivision of operating revenues and operating expenses, if desirable. This classification follows:

OPERATING EXPENSE ACCOUNTS.

A. Production:
- a. Station labor.
  - 1. Superintendence and care.
  - 2. Boiler labor.
  - 3. Producer labor.
  - 4. Engine labor.
  - 5. Electric labor.
- b. Fuel for steam.
- c. Fuel for producer gas.
- d. Water.
  - 1. For steam.
  - 2. For gas engines.
- e. Lubricants.
- f. Miscellaneous supplies and expenses.
  - 1. Production supplies.
  - 2. Station expense.
- g. Repairs, station structures.
- h. Repairs, steam plant.
  - 1. Furnaces and boilers.
  - 2. Boiler apparatus.
  - 3. Piping.
  - 4. Reciprocating engines.
  - 5. Turbines.
  - 6. Other steam equipment.
- i. Repairs, electric plant.
  - 1. Electric generators.
  - 2. Accessory electric equipment.
- j. Repairs, hydraulic.
  - 1. Dams, canals and pipe lines.
  - 2. Hydraulic equipment.
- k. Repairs, gas.
  - 1. Producers.
  - 2. Gas engines.
  - 3. Accessory gas equipment.

l. Repairs, miscellaneous.
1. Station tools and implements.
2. Miscellaneous station equipment.
m. Purchased energy.
1. Steam from other sources.
2. Water for hydraulic power .
3. Power gas from other sources.
4. Electric energy from other sources.

B. Transmission:
a. Patrol.
b. Maintenance.
1. Overhead transmission lines.
2. Transmission, subways.
3. Transmission, subway conductors.
c. Rent, transmission subways.
d. Substation labor.
e. Substation supplies and expenses.
f. Substation repairs.
1. Structures.
2. Equipment.
g. High-tension repairs.
1. Station structures.
2. Transmission equipment.

C Electric storage:
a. Labor, batteries.
b. Supplies, batteries.
c. Maintenance, batteries.
d. Repairs of accessories.

D. Distribution:
a. Expense.
1. Superintendence.
2. Maps and records.
3. Office.
b. Subway rent.
c. Maintenance.
1. Poles and fixtures.
2. Overhead distribution conductors.
3. Distribution subways.
4. Underground conductors.
5. Services.
6. Transformers.
d. Meters, expense.
1. Superintendence.
2. Setting and removing.
3. Testing.
4. Repairs.
5. Miscellaneous expenses.

E. Consumption expense:
a. Commercial arcs.
1. Labor.
2. Supplies.
3. Repairs.
b. Commercial incandescents.
1. Installation.
2. Renewals.
c. Municipal street arcs.
1. Labor.
2. Repairs.
3. Supplies.
d. Municipal incandescents.
1. Installation.
2. Renewals.
3. Repairs.
e. Inspection and repairs, consumers.
1. Inspection consumers' premises.
2. Repairs, consumers' installations.

F. Commercial expenses:
a. Commercial expense.
1. Department indexing.
2. Department collecting.
3. Department contracts.
4. Department accounting.
5. Department miscellaneous.
b. Promotion expense.
1. Management.
2. Demonstrations.
3. Other promotion, office expense.
4. Promotion wiring.
5. Promotion signs and devices.
c. Canvassing and soliciting.
d. Advertising.
1. Salaries and expenses.
2. Sundries.

G. General and miscellaneous expense.
a. Salaries and expenses, general officers.
b. General accounting labor.
c. General office supplies and expenses.
d. General law expenses.
e. Injuries and damages.
1. Employees.
2. Other injuries and damages.
f. Insurance.
1. Fire.
2. Accident.
3. Miscellaneous.
g. Printing and stationery.
h. Stable.
i. Storeroom.
j. By-products.
k. Electric franchise requirements.
l. Miscellaneous.
m. Amortization average.

OPERATING REVENUES.

A. Municipal street lighting:
1. Arc.
2. Incandescent.

B. Other municipal revenue:
1. Buildings.
2. Heat and power.
3. Miscellaneous.

C. Commercial light and power:
1. Flat-rate lighting.
2. Metered lighting.
3. Flat-rate power.
4. Metered power.

D. Railway companies.
E. Other electric companies.
F. Profit on merchandise sales.
G. Miscellaneous receipts:
1. Electric meters.
2. Motors, signs and appliances.
3. Electric jobbing.
4. Sale of by-products.
5. Joint electric rent revenues.
6. Break-down service.
7. Revenue from other operations.
8. Other miscellaneous revenue.

In discussing this classification, Mr. Dame said that the scheme seemed "in principle, at least, to be necessary if all accounts are to be on a uniform basis. This suggestion is made because in combining the accounts in the circular of the commission there has been some change in the nomenclature which it would be desirable to avoid. In the foregoing classification, which I have adopted from the printed form of the commission, there would be no change of title. The smaller companies would use only the lettered accounts, while the large companies would use the same accounts, and in addition would subdivide certain accounts by the numerical division shown. This can be done readily, showing the details on a report sheet by utilizing headings also for totals. By following this method we would obtain absolute uniformity in all companies, the lower-case headings giving the sum of the numerical division in the case of the large companies.

"My suggestion regarding such form would be that: (a) companies having over $500,000 annual gross should use the complete system in all its subdivisions; (b) companies, with

an annual gross of from $50,000 to $500,000, should use all lettered accounts only; (c) companies having an annual gross under $50,000 should omit the sub-accounts under 'B Transmission,' 'C Electric Storage,' 'E Consumption Expense' and 'F Commercial expense.'

"For a company under the lesser classification, where there was only one method of power generation and no storage or transmission, the total number of accounts would not exceed 28, which, I believe, would not be burdensome, since many of these accounts would not be very active."

In the same letter Mr. Dame brought up the question of the varying classifications of accounts for different classes of public utilities. He said on this subject: "I understand that the differences in gas and electric classifications, upon which I commented briefly at the hearing on June 24, have been due to a desire to accommodate the respective interests. This appears to have unintentionally worked a hardship on the small combined companies in setting up differences in parallel accounts (as, for example, in street lighting), which in the smaller companies are handled by the same department organization and bookkeeper. The feeling at the National Electric Light Association convention in 1907 was that the classification should be made as uniform as possible between the systems of that association and the gas and street railway interests. In putting this matter forward now it is with the suggestion that it be borne in mind in making future modifications of the various systems as the commission deems expedient. I am taking the liberty of making these suggestions because in my examinations of properties I am brought into contact with many small companies that cannot afford to have representatives attend public hearings."

Concerning the account "Incandescent Lamps" in the last tentative classification, Mr. Dame made the following criticism: "All incandescent lamps supplied to original installations without charge should be capitalized and treated in considering amortization to reduce the value to one-half, at which point the continuing renewals through operating would retain the value. Installations removed should be credited to this account. I believe this feature is more important than our discussion has yet indicated, as the new high-efficiency lamp will greatly increase the value of the connected load per kilowatt. Roughly, if carbon-filament lamps represent 1 per cent of total capital investment, the tungsten, at present cost, would represent 10 per cent for the same voltage capacity. The policy of companies on this lamp is not yet determined, but I believe this account offers the only possibility of a continuation of the old policy of furnishing original installations."

The following suggestion was made by Mr. Dame for future consideration in the analysis of accounts: "That all unit analysis be required on the basis of customers' meters. My experience is that there is no other point in the system where costs are comparable because of the great variation in the systems and combinations of systems of generation and distribution. Frequently the station with the lower generator cost shows the greater cost of current delivered. Owing to the use of electric auxiliaries in some cases and steam in others, the station costs are, of course, comparable only on feeder output, but I have found this very unsatisfactory because of the difference in distribution systems."

Preceding his criticism of the last classification, Mr. Dame wrote a letter commenting on the original tentative classification issued by the commissions. In this letter he said: "While the contents of this memorandum are necessarily critical, I want to take this opportunity of expressing the admiration I feel for the very able theoretical treatment you have given the subject, a treatment which I appreciate more completely since it is a matter with which I have struggled in a more or less unsatisfactory manner for several years. As you know, I am not an accountant, but I have been managing properties either directly or indirectly since 1890, and have more recently been employed largely in investigations from an investment standpoint, all of which duties have given me a view of the field under many different conditions. For a system of working accounts, I believe we should aim to:

"1. Eliminate such accounts as serve no valuable purpose, having the least number of accounts necessary to give information of importance.

"2. Keep operating expenses and repairs entirely separate, confined as nearly as possible to the expenses under working organization heads, and subdivided as nearly as possible on the most useful lines dictated by experience.

"3. Classify all expenses of a general nature together.

"4. Treat amortization and depreciation through one general reserve with a requirement for annual reports of charges to same in detail.

"I would suggest grading corporations into three classes:

"C—Those whose gross annual revenues from any class of operations are below $50,000.

"B—Those whose gross annual revenues from any class of operations are above $50,000 and below $500,000.

"A—Those whose gross annual revenues from any class of operations are above $500,000.

"This recommendation is based upon an experience of 19 years in building, rebuilding and managing street-railway and lighting properties, including four years examining physical condition and accounting of such properties for investment purposes.

"The $50,000-company is a comparatively small company, but is beginning to have sufficient volume of business to justify keeping its accounts in greater detail, and there seems to be very little necessity for a greater amount of detail until the business assumes much larger proportions. I have companies in mind having a gross of $650,000 which are splendidly operated with an operating classification of not over 50 accounts outside of their storeroom accounts.

"While there may be some exceptions to the rule, I believe an investigation of well-managed properties is the best criterion of commercial expediency in accounting and that no great good can come from adding to their expenses for systems of accounting greatly in excess of those demanded by permanent investors and operators of the better class of properties.

"The amount of detail which would swamp the $50,000-company, whose $60 per month clerk requires nearly 1½ per cent of the annual gross revenue for salary, would not be felt by the $500,000 company. Companies with over $500,000 gross can greatly decrease the proportionate labor in more detailed accounting because there is sufficient volume to their subdivisions of the business to permit the use of tabulating and other machines which are beyond the means of the small company.

"Perhaps the following figures from a company in a small Western city may be taken as typical of a great many $50,000 companies with non-condensing steam plants, and will serve to best illustrate the conditions met in a large number of plants of this size, and the small monthly distributions of expense to many of the accounts. Roughly speaking, the commercial business in the minimum summer month is only about one-half that of the maximum winter month, so that one-twelfth of the total for the year is considerably greater in variable items than the least amount charged in one month.

"The 27 operating accounts and the storeroom accounts were sufficient for this company, and it would certainly be a hardship for a much smaller company of this class to have more accounts to keep. The maintenance in this example is a little low, only 8 per cent of the gross (omitting 'Customers' Repairs and Renewals,' which do not belong in maintenance), whereas we look for over 10 per cent in plants of this character.

"You will understand this is not given as a representative $50,000 company. The above example has the common failing of many such properties in not providing for depreciation, and I wish to disclaim any interest in the above company except as an illustration of the point in hand."

Mr. Dame said that there will not be a distinct line between commercial light and commercial power metered because of the combined use of current to a large extent from the same meter. "If it were generally possible," he added, "to make a general classification of these items on the basis of price per unit it would be desirable, but the lack of any uniformity in rates except in a few localities makes such a classification of

little comparative value. As an illustration I want to call attention to the variety of rates by a few specific instances taken rather at random:

"New York City.—Uniform retail rate, 10 cents per kw-hour.

"Chicago.—Fourteen cents first 30 hours use per month, then

	Income.		Year.	One-twelfth.
	Municipal light, arc		$16,360.19	$1,363.35
	Commercial light, metered		22,366.39	1,863.87
	Flat rate		4,018.40	334.87
	Power service		9,609.14	800.76
	Merchandise sales (net)		*208.70	*17.39
	Total		$52,145.39	$4,345.45
	Less rebates and discounts		1,703.33	141.94
	Total income		$50,442.06	$4,203.51
	Operating expenses		35,452.44	2,954.37
	Net for interest		$14,989.62	$1,249.14
	*Loss.			
	Operating expenses.			
	Cost of manufacture.			
1.	Operating:	Power plant wages	$4,826.10	385.51
2.		Fuel	15,654.56	1,304.55
3.		Lubricants and waste	387.46	32.29
4.		Misc. supplies and expenses	178.15	14.85
5.	Maintenance:	Boilers	518.80	43.23
6.		Engines	208.00	17.33
7.		Electrical Machinery	180.00	15.00
8.		Miscellaneous	.....	.....
9.		Buildings and fixtures	59.61	4.97
	Total cost manufacturing		$21,812.68	$1,817.72
	Cost of distribution.			
10.	Operating:	Arc lamps	$1,344.42	$113.04
11.		Meters	383.95	31.99
12.		Renewal incandescent lamps	1,204.95	100.41
13.		Miscellaneous	55.10	4.59
14.	Maintenance:	Overhead system	3,031.11	252.59
15.		Arc lamps	98.27	8.19
16.		Meters	69.76	5.81
17.		Customers' repairs and renewals	660.26	55.02
	Total cost of distribution		$6,847.82	$570.65
	General expenses.			
18.		Salaries of general officers	$2,000.00	166.67
19.		Salaries of clerks	924.55	77.04
20.		Printing and stationery	151.28	12.61
21.		Storeroom expenses	242.02	20.17
22.		Adv., canv. and soliciting	1,506.75	125.56
23.		Misc. General Expenses and office sundries	489.22	40.77
24.		Legal expense and loss and damage	625.00	52.08
25.		Rents	200.00	16.67
26.		Insurance	661.76	55.15
27.		Taxes	491.36	40.95
	Total general expense		$6,791.94	$565.99
	Total operating expenses		$35,452.44	$2,954.37

8 cents for excess, with discounts applying only to the 8-cent rate on bills of from $100 to $1,000 per month running to 50 per cent on quantity.

"St. Louis.—Sliding scale, with sliding discount.

"Boston.—Sliding scale based on use of demand; rate is printed for distribution.

"Omaha, Neb.—Fifteen cents first kw-hour per 25 watts connected per month; excess consumption, 7 cents.

"Denver, Col.—One dollar and eighty cents per year per 16-cp lamp; $9 per year per consumer; 5 cents per kw-hour for all current used.

"Spokane, Wash.—Thirteen cents per kw-hour less than 25 kw-hours per month; 12 cents per kw-hour 25-40 kw-hours per month; 11 cents per kw-hour 40-60 kw-hours per month; 10 cents per kw-hour 60-150 kw-hours per month; 9 cents per kw-hour 150-250 kw-hours per month; 8 cents per kw-hour 250-625 kw-hours per month; 7 cents per kw-hour 625-1000 kw-hours per month; 6 cents per kw-hour over 1000 kw-hours per month.

"Buffalo, N. Y.—Graduated scale based on hours use per day of maximum demand.

"Cincinnati.—Ten cents per kw-hour with graduated discounts based on principle of Spokane meter rate.

"Cleveland.—Twelve and one-half cents per kw-hour for first 30 hours use; excess at 5 cents per kw-hour.

"St. Paul, Minn.—Sliding scale on average hours use per day starting at 11½ cents.

"Rochester, N. Y.—Similar to St. Paul, starting with 10-cent base rate.

"Minneapolis, Minn.—Published in curve form based on hours use.

"Schenectady, N. Y.—First 30 kw-hours, 10 cents; next 60 kw-hours, 8 cents; next 120 kw-hours, 7 cents; balance, 6½ cents.

"Detroit, Mich.—First 30 hours use of maximum demand, 16 cents per kw-hour; excess at 4 cents per kw-hour.

"San Francisco, Cal.—Nine cents per kw-hour for first two kw-hours per month per 16-cp lamp, then sliding scale based on kw-hours per 16 cp.

"Des Moines, Iowa.—Twelve cents per kw-hour for first kw-hour per 25 watts connected, then 6 cents.

"Chattanooga, Tenn.—Twelve and one-half cents per kw-hour per 25 watts connected, then 6½ cents.

"The above are also mostly subject to cash discounts for prompt payment and to minimum charges. It is also interesting to note that the rates allowed by the Wisconsin commission at La Crosse are: (a) Service charge, $1.80 per year per 16 cp on equivalent demand or one-third connected load. (b) For 60 hours or less use per month, 7½ cents per kw-hour. (c) For over 60 hours, 6 cents per kw-hour.

"Besides these meter rates most companies are now doing a very considerable flat-rate sign and window-lighting business based on the use of service through certain definite hours and switching on and off by the company employees. Much of the flat-rate sign lighting includes installments on signs furnished to the customer as part of the lighting contract and part of such revenue should be credited to the proper storeroom account.

"Furnishing free lamp renewals predominates, but is not general, and is being checked by the most costly high-efficiency lamps.

"There are no two of the above important situations with the same rate and it would be possible to show many more variations in the lighting rate and probably an even greater variation in power rates. There are a number of situations having uniform retail lighting rates similar to New York, but they are in a minority. In order to make this memorandum brief I have not tried to make the individual statements of rates complete nor have I included wholesale rates, except incidentally."

CURRENT NEWS AND NOTES.

FRUIT CULTURE.—Interesting experiments in fruit culture by electricity are being tried at the Marseilles Electrical Exposition. Tests have been made on strawberries, etc., and on such vegetables as asparagus. Conducting frames through which a current of from 1½ to 5 amp is passed are buried in the ground at various depths so as to subject the fruit and vegetables to thorough electrification in the soil.

WIRELESS IN PARIS.—A special cable dispatch from Paris states that a new wireless station is in process of erection on the Champ de Mars in which the apparatus will be so powerful that it is hoped eventually a message may be sent from it direct to New York. The station itself is underground, its place marked only by four poles which support wires running to the summit of the Eiffel Tower, which is used as an electrical conductor. The extreme height of the tower will enable the transmitters to send messages a very long distance. The new station was built by order of the Army and Navy Department as a consequence of the fine results obtained in sending wireless messages between the army in Morocco and the Presidential fleet in the Baltic. General Picquart, Minister of War, and M. Thomson, Minister of Marine, are directly responsible for the undertaking. Captains Ferrie and Frac will be in charge, and the station will be opened in January. The former Eiffel station had only 10-kw power and could communicate only as far as Morocco, on the one hand, and Nova Scotia on the other, but the noise of the spark could be heard clear across the Seine. The French recently decided to increase the station's power to 30 kw to communicate with New York City. If they kept the larger station on a level with the ground, its sparking would have annoyed all Paris. The buildings would also have spoiled the scenic effect of the Eiffel Tower's graceful base. So the government decided to put the station under ground. The superstructure of wiring—or antennæ—will be led up to the top of the Eiffel Tower, as before, by means of a chimney.

WIRELESS OVER 2900 MILES.—According to a despatch from San Diego, Cal., the Port Lima government wireless station has sent messages to and received replies from Admiral Sperry's flagship, *Connecticut*, which was 2900 miles distant on her course from Honolulu to Auckland, New Zealand.

LIGHT AND POWER IN A MODEL OFFICE BUILDING.—In our issue of July 11 there appeared an article descriptive of the electrical equipment of the German-American Insurance Building in New York City. The author inadvertently omitted to mention the fact that Mr. Henry C. Meyer, Jr., of New York City, was the engineer responsible for this very interesting installation.

CHRISTMAS BONUS TO ELECTRICAL EMPLOYEES.—In a letter to the London *Electrical Review*, the resident engineer of the Doncaster, England, municipal electrical plant, stated that each employee receives a "Box" at Christmas as a bonus. The contents depend upon the record of the employee during the year, deductions being made at the discretion of the manager. A good conduct stripe is also given with a full bonus.

A SERMON BY TELEPHONE.—The pastor of St. Paul's church, Fort Worth, Texas, recently delivered a sermon which was transmitted by telephone to a half-dozen saloons, a dozen or more business houses, 500 private residences and a score of offices. The telephonic arrangements, which were planned and carried out by Manager Lloyd E. Knapp, of the Fort Worth Telephone Company, did not interfere with the delivery to a large audience in the church.

CIVIL SERVICE POSITION.—The United States Civil Service Commission announces an examination at the usual centers on Sept. 2 and 3, 1908, to secure eligibles to fill a vacancy for inspector of mechanical and electrical engineering at $2190 per annum in the office of the Supervising Architect, Treasury Department, Washington, or for similar vacancies. The age limit is 20 for citizens of the United States. Further data can be obtained from the commission, at Washington, and applications must be filed by Aug. 22.

LONDON ELECTRICAL ENGINEERING STUDENTS.—Statistics of the Central Technical College and the Finsbury Technical College, the two principal technical schools of Great Britain, show a falling off in entries to electrical courses. In the former the decrease in the past several years was from 160 in 1904, to 135 in 1906 and 126 in 1907. On the other hand, students in civil and mechanical engineering have increased during the same period from 145 to 192 and 226, respectively. At the Finsbury College, the maximum of electrical engineering students—110—was reached in 1902, the total in 1907 being only 87.

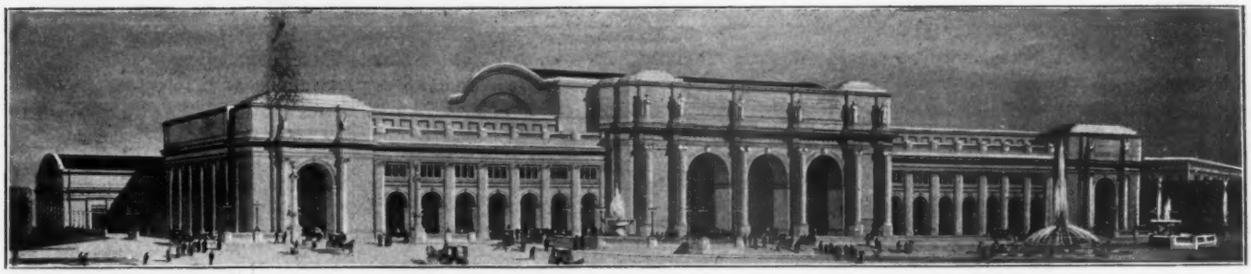
CENTRAL STATION ON WRECKED SHIP.—A member of the New York Maritime Exchange is authority for the statement that a town on the coast of Guatemala is being supplied with electrical service from the abandoned wreck of a German steamer. The steamer was wrecked some time ago off the shore of Ocos, a small town on the west coast, and while the hull has settled deeply in the sand, the dynamo and a boiler (presumably the "donkey" boiler) are not submerged and are in good condition. A Gautemalan engineer rigged up a line to the shore, put the electrical generating machinery in operating condition, and is now stated to be supplying the town with electric light.

AN INDIANA MUNICIPAL PLANT QUESTION.—A question of some importance has been raised in Richmond, Ind., by the refusal of the Light, Heat & Power Company to comply with the ordinance requiring it to place its Main Street wires underground. The company bases its refusal on the ground that it is being discriminated against in that the ordinance does not require the municipal light plant's wires to be placed underground, and that the city is permitting the municipal wires to be placed overhead in prohibited territory. The city contends that it is not required to place its Main Street wires underground because a city cannot legislate against itself. Attorneys say the question presents a fine point at law and will likely go to the Supreme Court for a final hearing.

THE CITY OF LIGHT.—Marie Van Vorst has in *Harper's Magazine* for August an article on "Paris by Night." The tinted photographs which were taken to illustrate her lively text reproduce the city's illuminations in many misty bulbs of light, reminding the observer, especially where the brilliant lines are strung along the Seine like a quivering necklace, that "Paris by night is like a beauty who wears her finest jewels at a ball." The small use of electric lighting in Paris, as compared with other cities, has lessened her claim, however, of late years to the proud title of the "Ville Lumière." Only a few main streets are brilliantly lighted, and there is a general absence of the brilliant effects seen nightly, for example, on the Great White Way.

AMERICAN ELECTRIC TRACTION is the subject of a long report by Sir Clifton Robinson, who revisited this country last winter to study once more its electric railway systems. He favors overhead trolley construction as against the conduit, objects to the double-decked car so familiar abroad as tending to slowness and congestion, and advocates "straphanging" on behalf of the man who wants to get home quickly. He thinks there is little prospect for municipal tramways in America. The people who have anything to lose have a wholesome distrust of local authorities, and "too often there seems to have been ample cause for it." He adds: "I revisited America last winter on my tour around the world, and was much impressed with the developments in street traction during my 20 years absence. It was exactly the beginning of these 20 years that witnessed the genesis of electric traction, and, remembering the period of its infancy, I saw before me its present maturity. The elevated railway, the surface tramway and the underground railway, all operated electrically, provide an enormous triple system of communication, and in New York I found myself revolving as it were in the most comprehensive and amazing demonstration of rapid transit that the world has yet produced. Still the transportation problem grows with the city's growth, and its true solution seems as far distant now as when 40 years ago I underwent there my street railway baptism."

SWEDISH ELECTRIC TRACTION.—It is stated by the *Railroad Gazette* that the trials made in operating electrically the lines from Stockholm to Järfra and Timteboda to Värtan, Sweden, have been virtually concluded, with very satisfactory results. As they are of general technical interest, the administration of the state railroads intends to publish an illustrated report with full details. On these trials is to be based the electrification of the entire state railroad system of Sweden, extending from Bollnäs, 200 miles north of Stockholm, to the southern coast. The state has already acquired several of the waterfalls that are to be used in connection with power stations. According to the estimates of Mr. Dahländer, chief engineer of the electrotechnical bureau of the state railroads, the total length of track that will be affected is 1400 miles. The conductors for the power stations are to be designed for 50,000 volts, the contact conductors for 15,000 volts. Approximately 37 transformer stations about 30 miles apart are to be used. The total cost for conductors, transformer stations, etc., will amount to $9,515,000, and for power stations to $6,460,000, with a total, allowing for sundries, of $16,400,000. Using the results of operating the steam railroads during 1905 as a basis, the total operating cost with electricity is placed at $1,578,000, as compared with $1,700,000 with steam, a difference of $122,000 in favor of electricity. With an increase of 60 per cent in the traffic, a condition that would probably obtain in 1920, the saving effected by electrical operation would be increased to $399,000. With an advance in the price of coal the results would be still more favorable.



UNION PASSENGER STATION AT WASHINGTON, D. C.

The Electric Lighting System of the Union Station, Washington, D. C.

SOME very interesting problems in lighting and power requirements are presented in the new Union Station at Washington, D. C. The construction of this new railroad terminal, which has involved the provision of adequate passenger facilities and an entirely new terminal layout for the railroad lines entering the city, wholly unhampered by the formerly existing railroad connections, presented an unusual opportunity for the design of a mechanical equipment that should embrace the most modern equipment and be thoroughly adapted to the requirements of terminal station service. The terminal is the result of the concentrated efforts of the District government and the Pennsylvania and Baltimore & Ohio Railroad Companies to eliminate grade crossings and to replace two passenger stations by a single station adequate for the requirements of both. The property consists of the Union Station, said to be the largest and most magnificent railroad station in the world; express building occupied by the Southern, Adams and United States Express Companies; power plant, locomotive and car repair shops; coach yard and several signal towers.

FIG. 1.—MAIN WAITING ROOM IN UNION PASSENGER STATION AT WASHINGTON.

POWER STATION.

In addition to the electrical supply for lamps and motors, the power station supplies steam for heating, compressed air for cleaning, brake testing and signals, and water for drinking, house service, fire protection, etc. As a result, a composite power plant is provided, large enough to supply immediate needs and having enough space to spare for additions to the equipment. The plant as designed provides for a total of 4200 boiler horse-power divided into 10 units, seven of which are at present installed. The boilers are of the Babcock & Wilcox semi-marine type with fire-brick-lined iron casings by means of which the great weight of the usual brick setting is avoided. They are fitted with superheaters and chain grate stokers. The settings, having the equivalent of the Dutch oven furnace construction, the combustion chambers of which are placed well within them, are unusually high, the tops being placed 22 ft. above the boiler room floor level. Reinforced-concrete, ash hoppers and waste coal pockets are incorporated in the floor construction. The layout of the station is shown in the cross-sectional elevation, Fig. 2. Instead of the usual arrangement of a large single unit economizer interposed in the main flue connection to the stack, a flue gas economizer is placed over each of the boiler units. The economizers were built by the Green Fuel Economizer Company. The two line shafts to

which the scraper gears are attached are driven by 10-hp induction motors.

The steam piping arrangement of the station is unusually simple, consisting of a 10-in. main steam header from which short, direct connections are made to the steam-using machinery. The engine room equipment consists of four 500-kw turbo-generators, three exciters and eight motor-driven arc machines, two air compressors, two pumping engines and the usual switchboards. The turbo-generators are of Westinghouse make and deliver 2300-volt, three-phase current at a frequency of 60 cycles. Worthington condensers are mounted directly beneath the turbines and a cooling tower equipment with four fans driven by 40-hp induction motors is used in connection with the condensing equipment. The 125-light Brush arc machines are driven in tandem by four induction motors rated at 200 hp. Two of the exciter sets are rated at 50 kw and are motor driven, and one rated at 35 kw is steam driven. There are two switchboards for controlling the electric circuits. The arc board is located at the southerly end of the station and the main board is located at about the center of the outer wall.

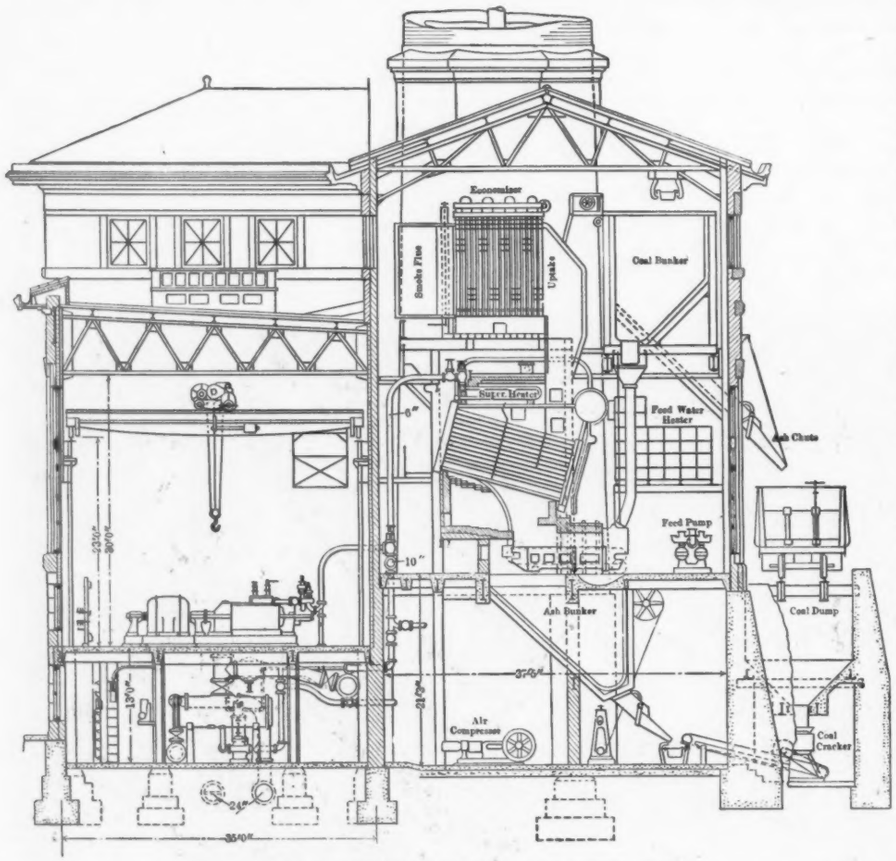


FIG. 2.—CROSS-SECTIONAL ELEVATION OF POWER HOUSE.

Service connections from the power plant to the express building and station are made through a pipe subway or tunnel running along the west retaining wall and under the north side of H Street. Piping for water, heating and refrigerating service is carried on supports suspended along the center line of this subway, while vitrified tile ducts, with manholes at convenient intervals, are built into the wall for the electric service.

Cables for electric service north to the coach yard, repair shops and signal towers are carried through a line of vitrified tile ducts laid in concrete between the tracks. Concrete manholes provided with cast-iron covers are located from 250 ft. to 300 ft. apart on straight runs, and at convenient points where the duct system crosses streets. Manholes are connected to the general drainage system.

The best of materials only are used in the lighting and power systems in order that they shall be as lasting as the building construction. Conduit furnished by the Safety Armorite Conduit Company, electro-galvanized both inside and outside, is used throughout, the smallest size installed being ¾ in. In the inspection of conduit the specifications, with reference to weight and dimensions, were very rigidly enforced, the requirements in this respect being the same as for standard-weight steam pipe. All short radius bonds were factory made and galvanizing was performed after bends were formed. All other bends were made by hand in the field and the heating of conduit for this purpose was prohibited.

Outlet, junction and all boxes for low-tension service are of heavy cast-iron construction. In many instances it was thought advisable to use specially designed material and apparatus in order to provide a lighting and power system in keeping with the other construction. Threaded connections, reinforced by locknuts and bushings, are used throughout between conduit and outlets in order to provide a continuously grounded system. In addition, the conduits are brought into contact with the steel framework of the buildings and at transformers, the neutrals of which are in every case grounded, a common ground connection is made. It is evident that the grounding of the conduit system has been thoroughly looked after.

The high-tension distributing system for incandescent lamps and motors is operated at 2300 volts and 60 cycles. Each transformer for lighting purposes and each set of transformers for motor circuits is served by an independent cable direct from the switchboard at the power house. Cables for arc service have either four or eight conductors, and serve from two to four loops. All motor-driven apparatus is operated from three-phase lines, while all incandescent lighting service is taken from one phase of the generator in order to secure as good regulation as possible to simplify the wiring.

All cables running north to the coach yards, shops and signal towers are lead-covered on account of the presence of moisture in the duct system. Those to the south are double-braided only, as the ducts in the wall of the pipe subway are reasonably dry and are protected from moisture. The single- and three-phase, 2300-volt cables are insulated with varnished cambric over a thin layer of unvulcanized rubber. These cables were subjected to and successfully withstood a test of 7500 volts for five minutes between conductors, and between conductors and ground, after being submerged in water for 24 hours at the factory, and 5000 volts for five minutes between conductors and the ground after being installed. Insulation resistance averaged well above 150 megohms per mile. The arc cables, both four- and eight-conductor, have each conductor insulated with rubber with varnished cambric over all. These were made up to withstand a test of 10,000 volts at the factory and 8000 volts after being installed under the conditions mentioned above. Insulation resistance averaged about 4500 megohms per mile. All high-tension cables were furnished by the General Electric Company.

Cruciform-core type transformers, with a ratio of 10 to 1, are used and are placed in fireproof vaults located at convenient points in the basement of the various buildings. The vault walls

are of brick built solid from the floor to the ceiling. The floor space generally covers an area of 100 sq. ft., giving sufficient room for the changing of transformers and parts without disturbing transformers in service. Vault doors are constructed of iron lined with asbestos, and are equipped with locks and keys, with sufficient height and width to facilitate the removal of apparatus.

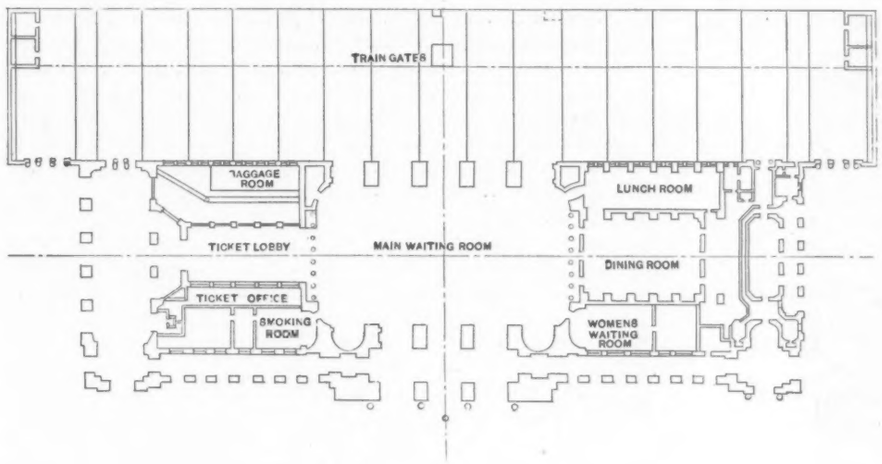


FIG. 3.—PLAN OF FIRST FLOOR AND CONCOURSE.

The high-tension cables in each vault terminate at a set of disconnecting switches mounted on the wall above the transformers. Expulsion-type fuses are installed between the switches and transformers. Low-tension feeder distributing panels, encased in ¼-in. sheet-metal cabinets, are mounted on the outside of the vault walls at either side of the door, connection to the transformers being made through iron-pipe conduit.

Three-wire 113-226-volt feeders are run from the feeder cabinets to distributing cabinets located at convenient points throughout the buildings, each feeder serving from one to five or six distributing cabinets. Distributing panels are encased in heavy sheet-metal cabinets and are equipped with three-wire buses and two-wire branches. Feeder circuits, buses and branch circuits are invariably controlled by knife switches, branch circuits being protected by plug fuses and buses and feeders by type A fuses. To secure mechanical strength, no switches smaller than 25-amp rating are used on branch circuits or smaller than 150-amp rating on main circuits.

After a number of distributing cabinets had been installed a change was made in the District regulations to permit the grounding, under certain conditions, of all electric fixtures not connected to gas piping. The general scheme of wiring was accordingly changed to profit by this change in regulations. All insulating joints are eliminated entirely. The neutral wire of the branch circuits is grounded to the conduit system at both the fixture outlet and the distributing cabinet—at the latter by means of a copper wire running entirely around the panel in the wiring space and connected with each neutral wire and the conduit system. The neutral wire of feeder circuits is also grounded to the conduit system at cabinets and at transformers by means of ground plate laid in charcoal under the vault floor. Neutral fuses in all feeder circuits are eliminated and solid copper bars substituted.

Okonite compound, of the thickness called for under United States Navy Yards and Docks specifications for low-tension wires, is used for insulating all the secondary wires. Feeders and tie lines are single conductor, and branch circuits, twin conductor. No electrical tests were required prior to installing. After installing, tests for insulation resistance gave results from 3 to 20 times greater than called for by the District regulations.

The lighting of large floor spaces is generally accomplished by the use of series direct-current arc lamps. General Electric form 10 and 11 lamps are used throughout and are suspended from cone-shaped insulators screwed into the outlet boxes. Loops from the power house control from 25 to 37 lamps each, individual groups being controlled by Gilbert porcelain cut-outs enclosed in cast-iron cases conveniently located. Solid No. 8 wire, insulated with Okonite compound, and run in 1¼-in. conduit, is used for arc service.

All other lighting, except that in the ticket lobby, which is furnished by tungsten lamps, is furnished by metalized carbon-filament lamps. In selecting the lighting units for each particular case careful consideration was given to the relative efficiencies, reliability and maintenance costs of all commercial lighting units, the conclusion being based upon data obtained from laboratory tests and from many installations in operation.

UNION STATION.

The Union Station, passenger concourse and train sheds cover a ground space of more than 18 acres. Thirty-three tracks, served by 19 platforms, enter from the north. Thirteen merge into two which continue to the south under the station and through twin tunnels running between the Congressional Library and the Capitol under First Street. The sub-basement and concourse basement are used for baggage purposes. The station basement is occupied by a portion of the ventilating and other service machinery and several transformer vaults, the balance of the space being held in reserve for future requirements. The

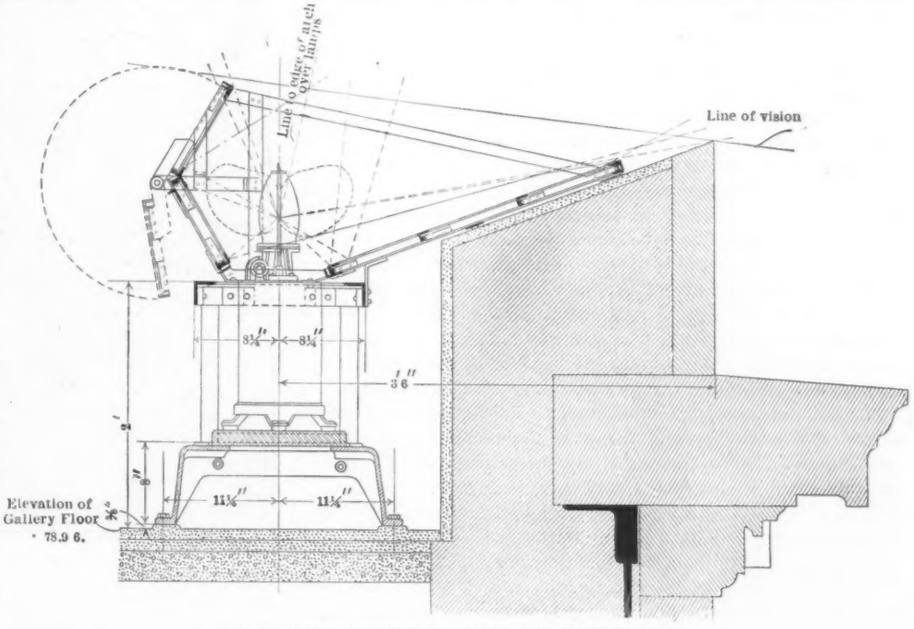


FIG. 4.—CROSS-SECTION THROUGH REFLECTOR FRAME.

first or street floor is occupied by the main waiting room, ticket offices, baggage room, dining and lunch room, women's room, smoking room and state apartments. The kitchen is located on the second floor. The balance of the second floor, the third and part of the attic floors are used for office purposes. A plan of the first floor is shown in Fig. 3.

MAIN WAITING ROOM.

In the preliminary design of the main waiting room it was decided to use some system of lighting by which the fixtures and

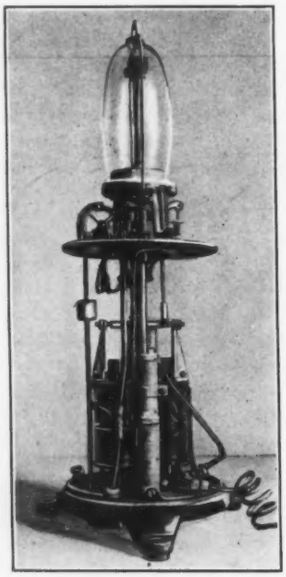


FIG. 5.—INVERTED ARC-LAMP WITH CASING REMOVED.

lamps would be concealed. The room covers a floor space of 120 ft. wide by 230 ft. long, and has a barrel-shaped ceiling of 60 ft. radius, the highest point of which is about 98 ft. from the floor. A series of five alcoves, which form galleries over the main entrance vestibules, runs along the sides of the room, with colonnades connecting the galleries across the ends of the room. The ceiling is light in color and is decorated with gold leaf. While not elaborate, the decorations are rich and in complete harmony with the fixtures and architecture.

Banks of especially constructed, inverted series arc lamps are placed in the alcoves back of the balustrade on top of the colonnades, with corrugated mirror reflectors behind them to throw the light to the ceiling, whence it is reflected to the floor. As an aid to the reflectors magnetic coils, which tend to draw the arc toward the waiting room, are installed on the lamps and give good results. To soften the light and reduce the bluish-white tint characteristic of arc lamps cathedral glass screens of a very light yellow tint are placed over the lamps and reflectors. An inverted lamp with casing removed is shown in Fig. 5. Fig. 6 is a rear view of the bank of lamps and reflectors in one of the alcoves, and Fig. 4 is a cross-section taken through one of the frames showing the relative locations of lamps and reflectors.

The lighting equipment consists of a total of 162 lamps so arranged that several combinations in the number of lamps in service may be had. A series of luxometer readings were taken with all possible combinations of lamps. From the results of these tests it was found that the corrugated reflectors and light-colored ceiling give almost perfect diffusion; that with all lamps burning, at reading distance from the floor, about 42 in., the illumination is practically uniform, the curves both north and south and east and west being nearly a straight line, and the values varying from 2.5 foot-candles in the corners of the room to 2.3 foot-candles in the center, thus making the use of auxiliary lighting on the seats for reading purposes not only unnecessary, but out of harmony in color and arrangement with the general scheme employed. The light is a very close approach to daylight and gives practically true color values in every part of the spectrum. Considerable difficulty was experienced in procuring the glass used to soften the color of the light as it is required that the glass should not absorb too much of one or all colors. By the use of the cathedral glass and clear inner globes a loss of but 16 per cent in the light was entailed, that being less than with an opal inner globe alone. Fig. 1 shows the west end of the waiting room and ticket lobby.

TICKET LOBBY.

The ticket lobby, located at the west end of the waiting room, is approximately 100 ft. long by 50 ft. wide, with a barrel-shaped skylight ceiling for natural lighting in the daytime. At first the use of a system of lighting similar to that in the waiting room, but with smaller units, was considered. A study of the conditions and tests of the glass indicated that it would be less expensive both in construction and maintenance to install individual lamps above each skylight. Tungsten lamps of 100-watt size with metal reflectors painted inside with aluminum paint are used. The lamps are arranged on four three-wire circuits, controlled by single-pole switches, so that half the lamps may be cut out of service without disarranging the symmetry of the lighted panels. The illumination in this portion of the station averages about 2.3 foot-candles, the quality of the light closely approximating that in the adjoining main waiting room and the distribution being as good. The reflectors used are of a special design and are so mounted as to direct the light toward the center axis of the arch. There are in all 225 lamps above the skylight, all being in a pendant position. A very small percentage of the light passes up, the major portion being directed down into the lobby below.

BAGGAGE ROOM.

The baggage room on the first floor is lighted during the daytime by 17 saw-tooth skylights through the ceiling of maze-glass panels. For artificial illumination one arc lamp is placed above each ceiling panel with good results. Each lamp is equipped with a large reflector. The skylight tile work has also been painted white with most pleasing results. The effect has been to destroy shadows and color rings, to smooth out and enlarge the distribution of the light, to make the color more mellow

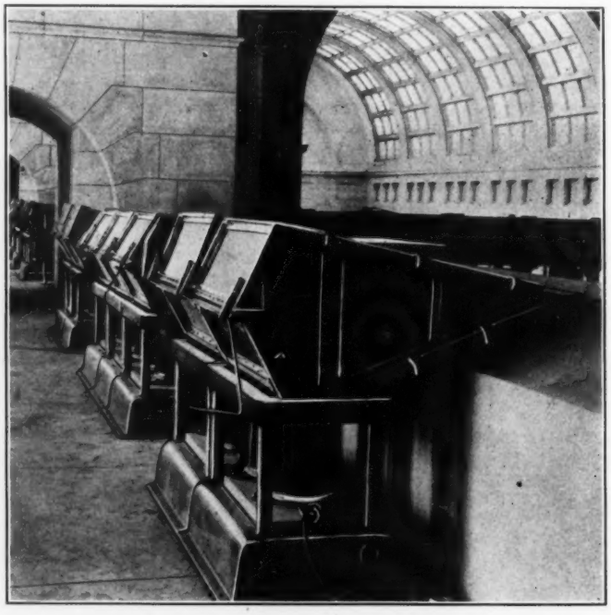


FIG. 6.—REAR VIEW OF REFLECTOR FRAMES IN ALCOVE.

and in harmony with that in the adjoining ticket lobby, to direct all the light downward and to reduce the annoying effects of flickering, arc traveling and feeding. The illumination in this room averages about 1.8 foot-candles and is both comfortable and sufficient for the work performed.

CONCOURSE.

The concourse occupies a space 755 ft. long by 150 ft. wide between the station building and train shed. It serves as a

means of passage to and from trains, and is lighted entirely by arc lamps suspended about 7 ft. from the ceiling. At this distance from the ceiling the lamps cast very slight shadows overhead. The absence of pronounced shadows is desirable on account of the paneling in the ceiling. It was attempted experimentally to light this space by placing arc lamps between the roof and ceiling over the skylights. The scheme was condemned principally on account of the steel work supporting the roof casting very pronounced shadows on the skylights and because the glass used has a very large absorption factor and is not uniform in color when lighted artificially. Series direct-current arcs did not give good results on account of the great loss due to absorption. Flaming arcs, by reason of their great quantity of light, gave good results, but were abandoned because of their pronounced yellow color being out of harmony with the general color values in other parts of the station and the high cost and difficulty of maintenance in the positions they occupied. Fig. 7 is a view taken from the west end of the concourse. Other experiments were also made in an effort to reduce the total number of units used, by employing large diffusers containing four and five units each. This, however, gave the effect of large units of high intrinsic brilliancy and was for that reason abandoned. It also produced objectionable streaks and shadows on the ceiling. This system would undoubtedly have worked out well had the ceiling been designed so as to have the diffusers set in it instead of below it. The reasons for abandoning this system were due to the original layout not conforming to its use and not to any faults in the diffusers themselves. With the diffuser installation the illumination on the floor was sufficient, pleasant and well diffused, the streaks and shadows on the walls and ceilings being due to the nonconformity of the building design and the necessary method of installation. The arrangement as shown in Fig. 7 was finally adopted as giving very good results with a reasonable cost of maintenance. Each lamp is equipped with a clear inner and opal outer globe, and the quality and distribution of the light are as good as could be desired. Means have been provided for a suitable casing to cover the wires and insulator directly above the lamp and a canopy to improve the appearance at the ceiling outlet. A collapsible and movable extension ladder is used in trimming these lamps.

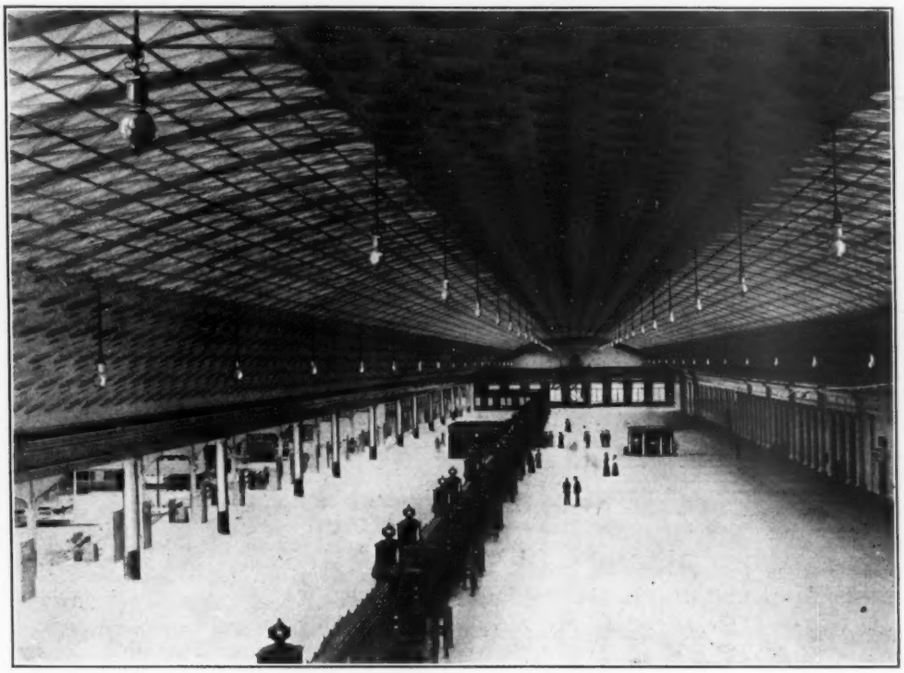


FIG. 7.—CONCOURSE IN UNION STATION, WASHINGTON, D. C.

MISCELLANEOUS.

The dining and lunch rooms, women's room, smoking room, state apartments and porticos are lighted from a series of ornamental bronze fixtures, which were described in the May 16 issue of ELECTRICAL WORLD. These fixtures show excellent workmanship, and are in strict conformity with the decorations and architectural features of the rooms in which they are placed. The ever-present glare of exposed fixtures, however, is noticeable and the irregularity of illumination is quite pronounced, illumination curves showing a variation in the dining room of from 2.1 foot-candles under the fixture to 0.7 foot-candles along the wall.

Some special lighting in the form of incandescent lamps with reflectors placed in coves formed in the cornices is installed in the main entrance to the state apartments and also in the vestibules. This system gives a very satisfactory effect, but the installation is too small to be of much value in gathering technical data. The ticket cases and counters, show cases in the drug store, news-stand and flower booth are lighted by Frink reflectors, the lamps being concealed as much as possible.

The lighting of the offices is uniform in design. One- and three-lamp fixtures, finished in dull black, are used. The sockets are arranged for vertically-suspended lamps, permitting the use of tungsten lamps at some future date, and for prismatic shades Each office is equipped with two or more ceiling fixtures, depending upon the size and shape of the room, and floor and baseboard outlets are installed at convenient locations. All ceiling fixtures are controlled by flush pushes mounted on wood mats on the walls. Hallways are lighted by Gem lamps varying from 50 to 125 watts and are encased in 8-, 10- and 12-in. globes according to size. The kitchen apartments are lighted and ventilated to some extent by combined fixtures and fans.

The train platforms are covered by umbrella sheds supported on cast-iron columns spaced 30 ft. apart along the center line of the platform. One hundred and eighty-seven watt Gem lamps, equipped with prismatic bowl reflectors, are suspended midway between the columns from especially designed outlet boxes attached to the steelwork of the roof. These give abundant light for loading and unloading trains and are readily accessible for renewals. They may, however, be changed to 100-watt tungsten lamps later with the desirable results of increasing the quantity of light and decreasing the total energy used. The signs and numerals over the entrance gates in the train fence are illuminated by incandescent lamps controlled by push-button switches located in cabinets containing the numeral boards for the time signs for outgoing trains.

The ventilating fans are operated from 226-volt, three-phase service and the dumb-waiters from 113-volt, direct-current service maintained from a 10-kw motor-generator set. The total load is small and is carried by three 75-kw transformers connected in delta. The Magneta clock system has been installed, the master clock being wound automatically by a small motor. A telautograph system has been installed for the use of employees only, its principal service being to announce to the employees of the baggage room and station and the express companies the time and incoming track number of arriving trains

The lighting of the signal tower is special to a considerable extent, it being very desirable to have the operating rooms as dark as possible so as to permit the operators to observe readily the movement of trains. All of the track and signal indicators and the lever machines are illuminated by 50-watt Gem lamps in

connection with special Frink reflectors, no other lights being used in the operating rooms.

EXPRESS BUILDING.

The express building is a three-story brick building somewhat more than 300 ft. long by 60 ft. wide. The basement or street floor and the first or train floors are used exclusively for the handling of express, while the second floor is used for office purposes. The basement and basement driveway, first floor and train shelters are lighted almost entirely by arc lamps, the lamps being controlled by some 12 or 15 cut-outs. The arrangement of the second floor permits the use of a uniform and symmetrical arrangement of lamps. One-lamp ceiling fixtures equipped with prismatic shades and 125-watt Gem lamps are used throughout, the fixtures being placed at the center lines of windows. This lighting especially has given general satisfaction.

POWER HOUSE.

The larger floor spaces in the power house are lighted by arc lamps, while the smaller machinery, passage-ways and offices are lighted by Gem lamps equipped with Holophane reflectors. The fixtures, as a rule, are made of ½-in. conduit, instead of ⅜-in., and without ornamental tubing on the outside. This arrangement gives a very strong and serviceable fixture. A multiplicity of extension plug outlets is provided, extension cords, equipped with Frink lamp guards and Pullman plugs, being supplied. Some 2½-in. conduit work at the power house was bent and shaped by hand.

The terminal is equipped with a private telephone exchange connected with the local, long-distance and railroad exchanges. Postal, Western Union and railroad telegraph services also enter the terminal.

With the exception of the ornamental bronze fixtures described in the ELECTRICAL WORLD in the issue of May 16, 1908, which were designed and purchased by the architects, D. H. Burnham & Company, of Chicago, Ill., all of the electrical work on the Terminal Company's property south of M Street was designed and constructed under the direction of the motive power department of the Pennsylvania Railroad.

All the electrical work above described was installed by A. S. Schulman, of Cincinnati, Ohio. Credit is due Mr. I. R. Prentiss, of the General Electric Company, for many valuable suggestions in connection with the lighting of the waiting room and other important portions of the station. Mr. W. D'A. Ryan, of the illuminating department of the same company, also gave valuable assistance in this direction.

On this page is an itemized statement of the kinds of lamps used, method of lighting and wattage per square foot for floor space throughout the buildings described in this article.

UNION STATION.

	Sq. ft.	Watts per total Sq. ft.	Watts.	System.	Kind of lamp.
Sub-basement	9,420	0.58	5,500	Direct	D. C. series arcs.
West basement	36,864	1.75	64,600	Direct	D. C. series arcs.
East basement	6,352	1.88	12,000	Direct	Arcs and gem
Ticket lobby	5,200	4.25	22,500	Concealed above glass ceiling	100 watt tungsten
Ticket office	1,536	2.05	3,150	Direct and concealed	Gem
Baggage-room	5,236	1.66	8,500	Concealed above glass ceiling	D. C. arcs.
Main waiting room	28,320	2.93	83,000	Indirect	Inverted D. C. series arcs.
Booth and special lighting main waiting-room	....	...	2,000	Special	Gem
Smoking-room	1,876	2.24	4,200	Direct	Gem
Barber shop	612	1.97	1,200	Direct	Gem
Toilets	1,818	0.87	1,640	Direct	Gem
Telephone space	508	2.26	1,150	Direct	Gem
South vestibule	957	2.82	2,700	Direct	Gem
Drug store	320	3.43	1,100	Direct	Gem
Parcel room	384	2.81	1,080	Direct	Gem
North vestibule	2,320	2.58	6,000	Direct	Gem
East colonnade	320	3.28	1,050	Direct	Gem
Women's waiting-room	2,720	1.54	4,200	Direct	Gem
Women's toilet	1,280	0.78	1,000	Direct	Gem
Dining-room	7,488	1.73	13,000	Direct	Gem
Lunch room	8,352	1.34	11,200	Direct	Gem
Steward's office	300	1.00	300	Direct	Gem
Serving-room	4,352	0.71	3,100	Direct	Gem
State entrance porch	2,560	1.09	2,790	Direct and concealed	Gem
Vestibule state entrance	720	5.20	3,750	Concealed	Incandescent
President's reception room	2,584	1.38	3,600	Direct	Gem
President's retiring room	224	2.67	600	Direct	Gem
Attendants' retiring room	224	2.67	600	Direct	Gem
Invalids' room	352	1.42	500	Direct	Gem
East driveway	9,600	0.52	5,000	Direct	D. C. series arcs.
East portico	1,344	1.76	2,400	Direct	Gem
South portico	7,680	0.52	4,000	Direct	Gem
Main entrance porticos	5,544	1.83	10,150	Direct	Gem
Carriage porch	11,744	0.84	9,900	Direct	Gem
Concourse	98,800	0.37	37,000	Direct	D. C. series arcs.
Concourse news stand	169	10.94*	1,850	Direct and special	Gem
Concourse ticket office	968	1.39	1,350	Direct	Gem
Concourse fire department and toilet	572	1.04	600	Direct	Gem
Station master's office	1,147	0.98	1,125	Direct	Gem
Stairways to tracks	800	1.87	1,500	Direct	Gem
Umbrella sheds	397,440	0.092	82,000	Direct	Gem
Train gates	....	...	15,000	Special	Gem
Mass. Ave. tower	384	2.08	800	Direct	Gem
East portion 2d floor	22,728	1.08	25,650	Direct	Gem
West portion 2d floor	16,032	0.91	14,600	Direct	Gem
East portion 3d floor	19,968	1.20	24,000	Direct	Gem
West portion 3d floor	9,276	1.19	11,100	Direct	Gem
East portion attic	16,652	0.57	9,600	Direct	Gem
West portion attic	17,472	0.20	3,500	Direct	Gem
Floor outlets	....	...	30,000	.....	.....
Total lighting load			557,135		

*Includes showcase lighting.

POWER REQUIREMENTS SOUTH OF M STREET.

	Total watts.
Small motors at station	225,000
Train tunnel fans	250,000
Battery charging motor generator	50,000
Motors, power plant and K Street tower	120,000
Total	645,000

EXPRESS BUILDING.

	Sq. ft.	Watts per total Sq. ft.	Watts.	System.	Kind of lamp.
Offices	25,080	1.34	33,000	Direct	Gem
Distributing space and offices	25,080	0.76	19,000	Direct	Gem and arcs
Storage space, basement	25,080	0.78	19,500	Direct	D. C. series arcs.
Driveways	33,880	0.33	11,200	Direct	D. C. series arcs.
Train shelters	26,670	0.42	11,200	Direct	D. C. series arcs.
Plug receptacles	....	...	5,610		
Total			99,510	.....	.....

K STREET SIGNAL TOWER.

	Sq. ft.	Watts per total Sq. ft.	Watts.		
Offices	3,630	0 60	2,200	Direct	Gem
Basement	1,800	0.42	756	Direct	Gem
Small motors	....	...	15,000	.....	.....
Total			17,956		

INSPECTORS' BUILDING.

	Sq. ft.	Watts per total Sq. ft.	Watts.		
Store room and lunch room	4,158	1.20	5,000	Direct	Gem
Offices	4,158	1.33	5,500	Direct	Gem
Basement	4,158	0.61	2,500	Direct	Gem
Total			13,000		

POWER PLANT.

	Sq. ft.	Watts per total Sq. ft.	Watts.		
Boiler room	7,800	1.63	12,716	Direct	Arcs and gems.
Engine room	9,000	1.22	11,000	Direct	D. C. series arcs.
Plug receptacles	....	...	28,050		
Total			51,766		

REFRIGERATING PLANT.

	Sq. ft.	Watts per total Sq. ft.	Watts.		
Attic	1,050	0.76	798	Direct	Gem
Second story	1,050	1.42	1,500	Direct	Gem
First floor	1,050	1.27	1,350	Direct	Gem
Basement	1,050	1.85	2,000	Direct	Gem
Total			5,648		
Pipe tunnel	....	...	2,500	Direct	Incandescent
Train tunnel	....	...	10,000	Direct	Arcs and incandescent.

SUMMARY.

Total connected lighting load south of M Street	757.5 kw
Total connected power load south of M Street	645.0 kw
Total	1,402.5 kw

Direct-Current Motors, Their Action and Control—IX.

BY F. B. CROCKER AND M. ARENDT.

The Motor-Generator and "Boost and Retard" Systems, both invented by H. Ward Leonard, are also multi-voltage methods of speed control, but the speed variations being gradual, no intermediate resistance steps are required. In the case of the

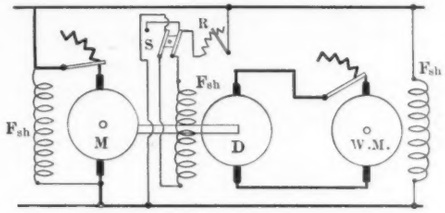


FIG. 1.—WARD LEONARD MOTOR-GENERATOR SYSTEM OF CONTROL.

*"motor-generator" system,** in addition to the working motor, a motor-dynamo is required for each tool so operated. The motor end (*M*) of the latter is connected to the line or supply mains and controlled as any ordinary single-speed machine (Fig. 1). The generator terminals (*D*) are connected to the working motor's armature (*WM*). Variable voltages and speeds are obtained by changes in the field strength of the generator, the field of which, as well as that of the working motor, being connected to the supply circuit. Reversal of rotation in this case is by means of a reversing switch (*S*) and rheostat (*R*) in the generator field. By this method the reversal of voltage applied to the working motor is gradually accomplished, being first reduced to zero and then built up in the opposite direction.

While this system is extremely flexible, it is not extensively employed on account of its great cost. The motor end of the motor-dynamo must be larger than the working motor by the amount of the losses in both the dynamo and working motor. For example, the 10-hp motor previously considered is of 86.6 per cent efficiency; to operate this machine at its rated load, the input must be $10 \div .866$, or 11.6 horse-power. The efficiency of the dynamo is also about the same, so the motor end of the motor-dynamo must be of $11.6 \div .866$, or 13.5 horse-power capacity. Thus three machines are required, each of a power equal to or somewhat greater than that needed for the actual work.

The most extensive use of this method of speed control is for the operation of turrets and gun platforms in modern armored ships, where the very fine adjustment and yet wide range in speed are necessary. It is now used also for driving of large rolls in steel mills.

Both of the Ward Leonard methods and the "teaser" system to be given later, involve motor-generator equipments. Their essential advantage is forcibly shown by the following example:

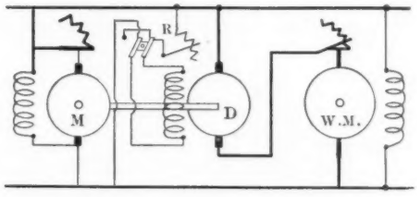


FIG. 2.—WARD LEONARD "BOOST AND RETARD" SYSTEM OF CONTROL.

To obtain 55 amperes at 12 volts, just sufficient to develop a torque to start the standard 10-hp motor from rest under load, would require a motor-generator of 80 per cent efficiency to draw $(55 \times 12) \div .8$ or 900 watts from the line, whereas to obtain the same starting torque directly from a 230-volt line by means of rheostatic control would require 55×230 or 12.65 kilowatts, which is 14 times as much power.

*U. S. Patent No. 463,802, Nov., 1891.

*The "Boost and Retard" System** reduces somewhat the high cost of the preceding method by the following scheme. A motor-dynamo is also employed, but the dynamo end is placed in series with the line, so that its voltage may be *added to* or *opposed to* the line pressure. The e. m. f. of the dynamo end is controlled by variation of field resistance, and its direction by reversal of field connections. The operation of this system may be understood by referring to Fig. 2. To have the same speed range with a 240-volt

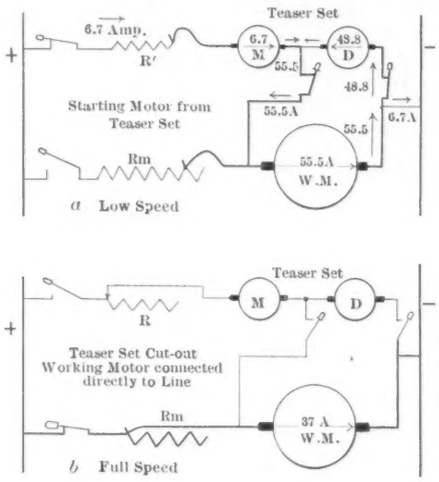


FIG. 3.—BULLOCK "TEASER" SYSTEM.

motor as with an ordinary multi-voltage system, the line potential is only 120 volts, while the dynamo end *D* also develops 120 volts. Thus if both line and dynamo pressures are in series, the voltage *V* at the motor terminals will be $120 + 120$ or 240. Decrease in value of *V* from 240 volts to 120 volts is obtained by weakening the field of the dynamo to zero value, while a reduction of *V* below 120 volts is obtained by reversing the dynamo voltage and thus subtracting it from the line pressure. This is accomplished by arranging the field rheostat *F* to reverse the field connections, the current in the same having been, however, first gradually reduced to zero, in which manner the high voltage and spark accompanying the opening of a field circuit are eliminated. Since the voltage of the dynamo end is only one-half of that required by the working motor *WM* at rated speed, the watt-capacity of the "boost and retard" equipment need be only a little more than

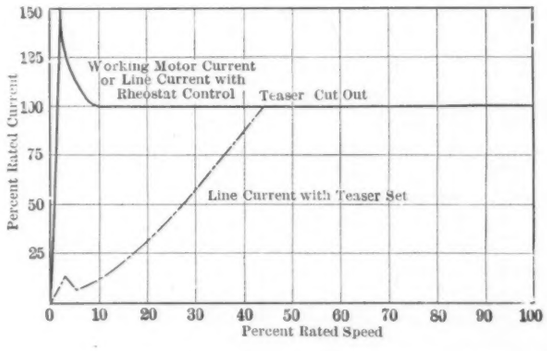


FIG. 4.—LINE CURRENTS, RHEOSTATIC AND "TEASER" CONTROL.

one-half that of the main motor and accordingly the unit *MD* is 50 per cent smaller than that in the preceding system.

The relations existing between the units comprising the "boost and retard" system are as shown in the following table, and it should be noted that when the generator end of the *MD* set is "crushing" or "retarding" the line voltage, the generator has reversed its function and is acting as a motor driving the motor

*U. S. Patent No. 572,903, Dec. 8, 1896.

end as a generator, which then pumps back into the supply line, supplying part of the current required by the working

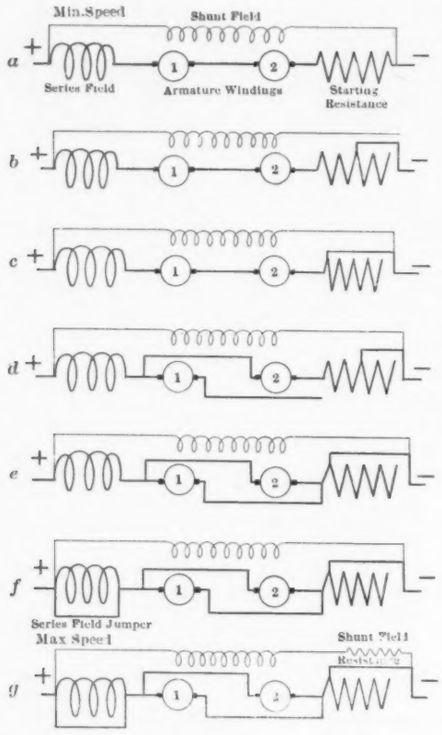


FIG. 5.—GENERAL ELECTRIC, DOUBLE-ARMATURE CONTROL.

motor, which develops 10 hp at rated speed (825 r.p.m.) and current (37 amp):

BOOST AND RETARD EQUIPMENT—CURRENT RELATIONS.

Working Motor			Motor-Dynamo				Supply Line	
Speed			Dynamo End		Motor End			
R.p.m.	Volts	Amp	Volts	Amp	Volts	Amp	Volts	Amp
0	11.8	37	—103.2	+37	115	26.5	115	10.5
206	66.3	37	— 49	37	115	12.6	115	24.4
412	120.8	37	5.8	37	115	— 2.3	115	39.3
618	175.3	37	60.3	37	115	—23	115	60.0
825	230.0	37	115.0	37	115	46.8	115	83.8

Examination of this table shows that this system of control is advantageous only at speeds considerably below the rated value, while at or near rated speed the efficiency falls from 86.7 per cent for the individual motor to $\frac{7640}{115 \times 83.8} = 71.6$ per cent for the combination of the motor and motor-generator.

Bullock "Teaser" System.

This arrangement is designed especially for printing press operation when the "inching" or slight forward movement of the press must be effected very accurately. While this could be accomplished by the two preceding multi-voltage methods the cost of the equipment is rather high, hence the development of this special method.

The apparatus and connections of the electrical units are as shown in Fig. 3. The "teaser" or motor-dynamo *MD* is of comparatively small capacity and its dynamo end generates a *low voltage*. The operation is as follows: The motor-dynamo acts as a current transformer, to supply currents of considerable value at low voltage to the main motor for starting large presses, inching them forward or even running them for long periods at very low speeds. The speed of the working motor *WM* is gradually augmented by increasing the speed and voltage of *D* by decreasing the value of *R* or by field weakening of the motor end until the main motor *WM* is rotating at such speed that it can be operated with comparative economy from the main line through the resistance R_m, at which instant the "teaser" is disconnected from the line and main motor. The great economy of the teaser system over armature rheostatic control is proved by the curves in Fig. 4 which show the current drawn from the line by the two methods when performing the same duty with the working motor. The dotted line compared with the solid line shows the reduction in line current with the teaser, the saving being more than 50 per cent up to about 30 per cent of rated speed. A little below half speed the teaser is cut out.

When the teaser generator is of the simple shunt type, a sudden overload or sticking of the press rollers stalls the entire equipment, because the terminal volts of *D* fall too low to produce the current required. To overcome this difficulty the recent modification known as the Bullock Teaser Booster equipment has been developed. This is essentially like the preceding, but the dynamo end of the teaser is compound wound, so that any tendency to stall the working motor *WM* increases the current; thus the voltage of *D* and the motor torque are sufficiently augmented to carry it over the sticking point.

Holmes-Clatworthy System.

This is similar to the teaser system in principle, but the low speed for starting and inching purposes is supplied from a special low-speed motor. The complete equipment consists of a main or working motor, an auxiliary motor and a controller. In addition there is an electrically operated self-releasing clutch, situated between the two motors, by which the turning effort of the auxiliary motor is transmitted through worm gears to the press. The auxiliary motor is wound for such a speed that by means of the gearing it will drive the press for all purposes of starting up, inching, leading in, etc., and run the equipment up to such speed where the torque is at the normal value, thus permitting the main motor to take up the load without injury. As soon as the main motor overspeeds the auxiliary one, the self-releasing clutch is automatically operated, and the low-speed machine is disconnected.

Double Armature Method.

This method of motor speed control is placed under the general head of multi-voltage system, because even though the line voltage remains constant, variable speed is obtained by varying the voltage applied to a given armature, thus producing the

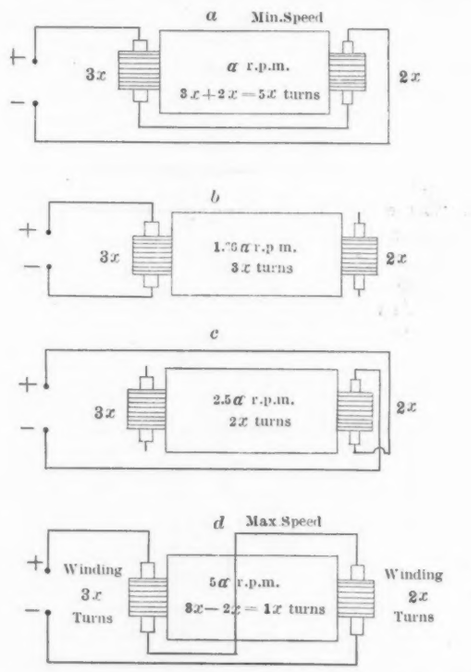


FIG. 6.—COMMERCIAL ELECTRIC COMPANY'S DOUBLE-ARMATURE METHOD OF CONTROL.

same result as by reducing line voltage. There are two general designs of this class. The principle is the same, but with the first only two running speeds are obtained due to the armature windings being used independently or in series, while in the second four speeds can be obtained by variations in

the manner of connecting the two armature windings to the circuits.

The first method (G. E. Co.* and C. & C. systems) employs a motor with an ordinary field frame and winding (may be compound wound) but the armature core is provided with two windings and two commutators, the windings being alike in all respects. Thus if one armature be placed across the line a certain speed x will be obtained. If both are placed across the line in series, a certain running speed $\frac{1}{2}x$ will be obtained. In fact this double-armature method is closely similar to the series-parallel control of railway motors. The various steps of this method of regulation from starting to maximum speed are shown in Fig. 5.

The second type of this class, developed by the Commercial Electric Company, employs one common field frame and winding (shunt or compound) and two independent armature windings, but instead of having these alike in number of inductors, one of them has $2x$ inductors and the other $3x$ inductors —i. e., one has 50 per cent more inductors in series than the other. Thus if the $2x$ winding be opposed to the $3x$ winding (connected in series to line), only x inductors are effective in producing the c. e. m. f., hence the speed would be a maximum. If the winding with $2x$ inductors were connected by itself to the line, a speed of one-half the maximum would be obtained. If the winding with $3x$ inductors were placed across the line a speed of one-third the maximum would be obtained—while if both windings were placed in series across the line a speed of only one-fifth the maximum would be the result. The general connections for these steps are shown in Fig. 6. If used in combination with field or with rheostatic control this method would give an extremely wide range; for example, a 6 to 1 field range would give a 30 to 1 speed range.

Speed Control by Variation of Number of Poles.

The Bullock Company at one time manufactured a motor capable of giving various speeds by changing the number of poles. For example, consider a six-circuit armature with a six-pole field. With the poles so excited that the ordinary relation exists we would have a speed of

$$x \text{ r.m.p.} = \frac{e\,10^8\,60b}{n\phi\,2p} = \frac{e\,10^8 60}{n\phi}.$$

If, then, the relation of the field coils be changed so that three poles adjoining each other become S, and the other three N, we would have with the same impressed voltage a speed in r. p. m. $= \frac{e\,10^8 60}{n\,3\phi}$ or $\frac{1}{3}x$ because the armature winding becomes a two-circuit one, the number of poles being two, while the flux per pole has increased to three approximately (provided the yoke and armature have sufficient cross-section to carry the increased flux). Hence the speed in the second case would be only one-third of what it was in the first instance. The cost of this design is so great, due to larger frame, complex windings and switches, that it has not been commercially successful.

Troubles of Central Station Switching Apparatus and Methods of Handling Them.

By C. F. Conrad.

As long as everything runs along smoothly, the operation of a large switchboard is very simple, and the duties of the operator are apt to become monotonous; however, there is always the possibility of trouble in one form or another, and as it usually comes suddenly and without warning, it lends a spice of excitement to the work, and keeps the operator on the constant lookout for the slightest indication of trouble.

For stations supplying a number of cities and industries it is of the greatest importance to maintain continuous service. The monetary or financial loss due to a short interruption is slight compared to the damage to the reputation of the company. Consumers demand reliable service and if the company once gets the name of being unreliable new business will be extremely hard to get. The switchboard operator should fully appreciate this; he will then understand why it is preferable to take the risk of seriously disabling apparatus than lose the load, and never to pull the machines out of circuit unless the case is absolutely hopeless.

Nearly all trouble culminates in some form of short circuit, the intensity of which may vary widely, and is influenced by quite a number of factors. For the purpose of this discussion, assume the system to be as follows: Twelve 2000-kw 60-cycle alternators, direct-connected to water turbines and generating current at 2400 volts, which is stepped up to 40,000 volts for transmission and stepped down to 2410 volts at the substations for feeder distribution and further reduced to 480,240 or 120 at the point of consumption. These small transformers are protected on both sides by suitable fuses, those on the 2400 volt side being, say, 50 per cent to 200 per cent higher than the capacity of the transformers. The feeder has a circuit breaker at the substation set about 100 per cent higher than the load on the feeder. The high tension line breaker at the power house is set 50 to 100 per cent higher than the load on the entire line, but with a longer time limit than the feeder breaker, say, 4 to 6 seconds respectively. The use of generator switch relays depends principally on the characteristic of the generator or its ability to hold up the voltage under a short circuit and the resulting current. If on a dead short circuit of low resistance the current is of such a value that it would not burn out or seriously injure the winding of the machine in a few minutes, the relays can be dispensed with; but if under these circumstances the machine would supply a current of such a volume as to seriously injure the winding in a short time; then the relays should be used, and their time limit set to protect the machine. In the one case on a dead short circuit and failure of breakers to relieve the short the operator must pull the machine out of circuit by hand; in the other case the machines will protect themselves provided the relays are not set too high. If the relays are set too high even with the machine running over speed and with a heavy field, the voltage may fall to such a value that the resulting current may not be heavy enough to trip the switch out; however, in such cases the machine can usually stand this current for a short time, and the operator could clear the machine by hand.

As to the effect of any short circuit on the load, there are so many things to be taken into consideration that it is quite impossible to say how much load, if any, would be lost for any specific short circuiting current. With a system carrying a mixed load of 60-cycle rotary converters, supplying a railway load, synchronous motors and induction motors of various sizes on a short circuit of comparatively large volume there is sure to be some loss of load. If the short circuit should cause a momentary drop of, say, 40 to 60 per cent in bus voltage, 60-cycle rotaries would fall out of step and kick their breakers out. Heavily loaded synchronous motors would also kick out, and also some induction motors will stall and blow their fuses. The question as to whether a machine will kick out on a certain drop in voltage also depends on the load on the machine at the instant the drop occurs. Relays, especially of the closed-circuit type, should be kept in good condition and the time limit feature retained, otherwise they will open instantly on a short circuit or heavy overload. Sometimes, the small disk that bridges the contacts becomes corroded and does not make good connection, or, if the disk fits too tightly on the plunger, and the latter vibrates or starts to raise, it may move the disk sufficiently to break the connection and open the switch.

Now, suppose a consumer accidentally causes a dead short circuit on his service. The tendency is to blow the fuses on the low tension side of his transformers; this, of course, is the desired result, as these fuses can be replaced by the consumer. Trouble of this nature has little or no effect on the voltage, for a large consumer it may cause a momentary drop of several volts. It may also blow the primary fuses, and in such cases it is reported to the nearest substation and a trouble man is

*U. S. Patent No. 757,394, April, 1904.

sent out to replace the fuses; thus the interruption is confined to one customer.

If the relay at the substation is of the simple overload type without time-limit features or of the time-limit type and out of order, trouble of this kind may open the feeder circuit-breaker and would then interrupt all service on the feeder. It is usual to hold the feeder switch open a minute or two to give consumers time to open their switches or throw their motor starters to the off position, because, as a rule, alternating-current apparatus has no automatic, no voltage release; otherwise cutting in a feeder with large motors on with their starting box levers at the running position is liable not only to blow their fuses, thus causing additional delay, but also to cause a serious drop in the bus voltage, similar to a short circuit, and may cause other apparatus on other feeders to drop out. It is preferable to have the primary fuses on customers' transformers of such a rating as to blow only on serious trouble—that is, to confine the trouble to the fuses on the low tension side.

Fuses of any type on circuits of 2400 volts or more are more or less unreliable. This is in part due to the fact that the arc caused by the fuse blowing produces a metallic vapor, which forms a path of low resistance and will allow high voltages to hold an arc across quite a large gap, and as these fuses are usually of the out-door type enclosed in an iron box which may be partially grounded, this metallic vapor may provide a path for the current to jump to the box. Two fuses blowing simultaneously would therefore produce a dead short circuit of low resistance. If the feeder switch relay is set to open, say in 2 or 3 seconds, and the high-tension line switch at the power house is out of order as regards time limit, it may open the high-tension switch, interrupting all service on that line, besides the risk of serious loss of load on other lines. Therefore, 2400-volt fuse boxes should be very carefully installed and all relays kept in good order.

A short circuit due to lines swinging together or other lines falling on a feeder will have practically the same effect and the substation circuit-breaker should relieve it promptly, and without pulling the bus voltage down more than 10 or 15 volts. The effect of lightning on a feeder is similar to a momentary short circuit, and varies with the intensity of the discharge. Several years' experience with lightning arresters of the air-gap type, and having no resistance in series with the gaps, leads me to believe that they are practically worthless for circuits of 2400 volts or higher, and fed by a plant rated at thousands of horse-power. The arresters almost invariably arc and burn the so-called non-arcing metal together into a solid mass, causing a dead ground. Frequently two are affected simultaneously, putting a dead short on the feeder, and it must be left out of service until the trouble man can clear it. The same type of arrester provided with a high resistance in series with the gaps has given excellent service.

Short circuits and lightning on a high-tension line have about the same effect on the system as similar trouble on the feeders, except the effect is much more disastrous. The drop in bus voltage on a short cleared by the high-tension line circuit-breaker may vary from about 25 per cent to 80 or even 90 per cent. When the feeder circuit-breaker opens at a substation, it is closed after the customary interval of time has elapsed. If the switch is of the type that is automatic during the act of closing, no special care need be exercised in putting the feeder back into service, as to whether or not the trouble still exists; but if the switch is so constructed as to be non-automatic while closing, the operator should be very careful not to jam the switch shut and hold it in, because if there happens to be a permanent short circuit on the feeder, this will open the high-tension line switch at the power house, interrupting all service on that line, besides losing load on other lines.

Some switches are so constructed that when the switch opens there is a corresponding movement of the switch handle, and in closing the handle has to be held steady and the pressure of the hand released gradually to be sure that the switch is securely closed. It is with this type of switch that especial care is necessary to prevent further trouble. It is a good plan to close the switch, so as just to touch the auxiliary contacts and let it fly right open again, watching the ammeter; if there is a dead short on the feeder the needle will fly over the scale and there will also be a noise inside the switch as though the oil were boiling violently. If after three or four trials there is no indication of clearing, the feeder must be left out until the trouble is cleared. If the ammeter indicates a clear line the switch may be immediately closed. If the switch is of the type in which the handle remains in the closed position, when the switch kicks out the above method may be used or the switch may be closed quickly, as it will be impossible to hold this type closed on a short circuit. However, there will usually be less shock to the system by tipping the contacts than by closing the switch suddenly as with the latter type.

Short circuits on the high-tension lines or apparatus will cause a quick drop in the bus voltage, and the effect on the system is usually very severe. When operating a number of high-tension lines in multiple and one opens on a short circuit, great care must be exercised in putting the line back in service. Any trouble which causes a permanent short circuit will necessitate holding the line open for repairs. Frequently, a stroke of lightning will cause a momentary short, the generator current following the discharge across the gaps of the lightning arresters. Ordinarily the severe drop in bus voltage assists the arresters in extinguishing the arc and the voltage instantly comes up to normal or higher if any load is lost. If the discharge is of any strength, it may open the high-tension circuit-breaker and if the arresters are not burned together, the line would be clear and could be immediately pulled back. However, there is no way to ascertain definitely the exact condition of a line without loss of time, and it is better immediately to notify the substations to cut in on the spare line, and after service is restored to test out the defective line on a separate machine.

If there is a private telephone line on the transmission poles or towers it serves as an excellent ground detector. As sometimes happens, the spare line may be defective and if so it would immediately put the telephone line out of service. The power house attendant should cut in on the spare line first and if there should be trouble on the line that would prevent the use of the telephone he can immediately trip his switch out. It is also well to do this when changing high-tension lines, because if the substation cuts in first and the telephone goes out of service, there would be the liability of error for loss of time in getting into communication over other telephone lines. It is a great convenience to have ammeters on the high-tension lines, so the power house attendant can tell if the substation men open the proper switch. This is a precaution against possible error. A delta-connected high-tension line may be operated with a heavy leak or a slight ground on one leg; but it is well to cut in the spare line as quickly as possible.

In case the high-tension switch is non-automatic during the act of closing it, and there is an important load on other lines, it would be very risky to throw the switch in directly after it opens on account of any trouble. There may be a dead short on the line and cutting in under these conditions would result in the entire loss of the load. If it is necessary to cut the same line in again, it would be better to cut the line on the spare high-tension buses. Connect a spare set of transformers on these buses and then close the switch on the low-tension side of the transformers on the live bus. If the short still exists the high-tension switch would again kick out, and the line would have to be left out and the trouble men sent to clear it. If the high-tension switch is automatic while closing it could, of course, be thrown in immediately, but if the trouble still exists there would be a severe drop in bus voltage and additional loss of load. If the switch is of the motor-operated type which would close the switch tight and hold it for a second before tripping out, there would be danger of great loss of load; in fact, nearly everything but lamps and small motors. In case the same line must be used another method, and probably the best, is to cut the line on separate apparatus altogether, through

to the switchboard, and then connect a separate generator in. If clear, the line can be immediately cut out and connected on the regular bus; if not, any apparatus that shows signs of trouble, as arresters, transformers, etc., should be cut out and another trial made. If all the apparatus is in good condition the trouble will probably be in the line, and if it does not burn off after a few trials the line will have to be left out of service and repaired.

Trouble from over-heated contacts or connections give notice by a strong odor of burning insulation or, if bare, by the metal becoming discolored and corroded. Sometimes, insulated joints become hot enough to ignite the insulation. There is usually ample time to cut in spare apparatus, before any serious damage is done.

The switchboard operator should be perfectly familiar with the switching system, so as to be able to make the changes quickly and correctly. It is also of great advantage to know how the switchboard is wired, especially the instrument connections, as it is possible to guess the nature of some trouble by the action of the instruments.

On any Y-connected system with a grounded neutral, a ground on one leg would be a short circuit and render operation of that line or feeder impossible until the trouble is cleared. If the neutral is grounded at only one place, if necessary it would be possible to operate temporarily a 2400-volt feeder or bus by disconnecting the neutral from the ground.

Almost all trouble finally reaches the switchboard in the form of a short circuit, and the manner in which the generators are operated determines the method of handling it. If there is a governor on each machine the speed is kept at normal automatically, and the loss of load will simply cause an increase in the bus voltage. The attendant will then have to reduce the voltage to normal and keep raising it again as service is restored; but, if some of the machines are set by hand, and the loss in load is more than that carried by the governor machines at the time, there will be a tendency to race, because there will be more power generated than is being used and the excess tends to raise the speed of the machines. One or more of the hand set machines must therefore have its gates closed as quickly as possible, until there is some load on the governor machines and the governors will again regulate the speed. While the men are closing the gates, the operator must keep the voltage as near normal as possible and as the load comes on again, the gates must be opened as needed.

There should be some arrangement to operate all the field rheostats simultaneously, and the control switch for this purpose centrally located. When a generator opens its circuit-breaker, the speed instantly increases, also the voltage. If there is a governor it will close the gates; if not, they must be closed by hand and the rheostat resistance must be immediately cut in to reduce the voltage. As a general rule with a wide open gate and no load, the speed of a water-wheel is limited to about double normal speed. In closing the gates they should be set to hold the machine at speed so it can be cut in promptly when needed.

Frequently, a governor machine at no load will have a tendency to race and it is sometimes necessary to have a man steady it to synchronize. Balancing the load on the governor machines must be done by changing the speed of the prime-mover. It is useless to attempt to do this by adjusting the field charge, as this has no effect whatsoever on the proportion of load taken by the machine. It is a good plan to have one governor set accurately at the exact speed and to adjust all other governors by it. The other adjustments of the governors such as dashpots, main valve opening or the quickness of action and time it requires the governor to return to normal speed after any change in the gate opening, should be approximately the same.

Racing is generally due to the adjustment of the governor dashpot, and will sometimes open and close the turbine gates rapidly, causing wide fluctuations in speed and voltage. If there is governor control on the switchboard, the machine can be adjusted either to open or to close the gate fully and hold it in the desired position until the dashpot can be adjusted. Racing is more apt to occur when there are only a couple of machines in parallel and the load drops off, leaving the governor machines with a light load. On the Lombard governor the dashpot should be adjusted to bring the governor back to speed with the machine. If it is too sensitive, the governor will return to speed too soon—that is, before the water due to the changed position of the gates can bring the speed of the turbine to normal; this will result in an additional movement of the gate, and the dashpot should be adjusted so as to be less sensitive. If the dashpot is too stiff then the governor will be too slow and result in bad regulation.

For racing, when there is no switchboard control on the governor, the operator can only try to prevent the extreme variation of voltage by using rheostal control, and if the governor can not be adjusted immediately, the load on another machine may be lightened, thus loading up the governor machine. There is practically no danger of machines falling out of step when racing; the only bad results are as before mentioned, a wide variation in speed and voltage. The effect of line trouble on the system is also affected by the number of machines in service, due to the fact that a small number of machines will sometimes be unable to furnish the volume of high-tension current necessary to open the high-tension circuit-breaker. For instance, if a breaker is set at 200 amperes on the 40,000-volt side, say, two machines may be unable to furnish sufficient current to trip the breaker. On a permanent short circuit it would interrupt the service entirely and necessitate opening the circuit at the switchboard, unless the attendant can trip the high-tension switches from the board. Even then he may not know which line is in trouble. It will usually save time to open all the high-tension lines, cut a generator on the busbars and then throw the lines in. When the one in trouble is reached there will be a short, and it can be left out, after cutting in the remaining lines and restoring the service. The defective line can be tested out separately.

Trouble due to a break down in the machine or its leads before reaching the transformer can only be protected by means of the reverse power relay, and these are seldom installed. Although trouble of this kind is rare, it does occur, and usually results in a complete shut down, as it is very hard to tell which machine is in trouble quickly enough to cut the machine out in time to save the load. Special precautions are used in providing a reliable source of supply of direct-current for field excitation; any interruption will, of course, result in a shut down. In case of failure, if the machine switches are held in mechanically it will not be necessary to synchronize the generators. The generators should be adjusted to run near speed and the spare exciter started and allowed to come up to speed very slowly, raising the voltage very gradually, and the machines will pull into step. The exciter switches are, of course, closed as well as the generator field switches before starting the exciter. This method is rather hard on the machine instruments, as they will fluctuate violently until the machines are running in synchronism. In some cases the generator switches are held in by the exciter current, and, of course, on its interruption they will all come open, and usually cannot be closed until the exciter is near normal voltage. In such cases it would be necessary either to close each switch by hand and block it in or to synchronize each generator. The latter would probably save time in the end.

The private telephone lines should all be brought to the switchboard and each line equipped with a small switch, so that all may be cut on the one telephone instrument. When there is a ground or leak on any high-tension line it will affect all the telephone lines. The operator can then cut the telephone lines off one at a time and locate the defective high-tension line. There should be a well-insulated platform or a dry box for the operator to stand on while using the telephone. During trouble the switches may be opened with a dry stick, as it is well to be on the safe side.

All trouble should be immediately investigated, its cause ascertained as fully as possible, and steps taken immediately to render a repetition impossible. In the course of time this will

produce remarkable results in freeing a system from ordinary trouble. The prevention of trouble is of far greater value than handling it after the damage is done.

SUBSTATION OPERATION.

The duties of the substation operator have been mentioned in regard to cutting in feeders after they open their circuit-breakers. The care of large transformers is very simple; they are usually of the oil filled water-cooled type. If there is an abundant supply of water, say, from a well and pumped by a small motor, the transformers may have the supply of water adjusted to keep them cool at full load, and the supply need not be reduced for light load. The transformer will run this way with no more care than to see that the supply of water is uninterrupted. If the water is purchased by meter the supply can be regulated to keep the transformer at the safe temperature; however, saving water and running the transformer at a high temperature will result in a breakdown of the insulation; it also ruins the oil. When the oil thickens and does not circulate freely it should be filtered. It will pay in the end to run the transformers as cool as possible, but they should always be warmer than the surrounding air, or they are liable to sweat inside, thus introducing moisture into the oil. At regular intervals a sample of oil should be drawn from the bottom of each transformer and examined for water. If the water pipes inside spring a leak it will be immediately indicated by a rise in height of oil level, although this level will change as much as half an inch for a difference of 15 or 20 degrees in the temperature of the oil, but any excessive variation usually indicates trouble of some kind.

On a delta-connected system if a feeder becomes grounded on one leg, the service need not be interrupted, or if the same leg of two different feeders become grounded, they may still be operated; but should unlike legs of two feeders become grounded there will result a short circuit through the ground and it will be impossible to operate the feeders in multiple. However, if one of the feeders is out on a spare busbar fed by a separate bank of transformers service may be held on both feeders; the transformers may be in multiple on the high tension side but must be separate on the low tension side.

Never attempt to disconnect any circuit or apparatus by opening the common knife switch on the high-tension side; always use an oil switch. In connecting large banks of transformers together, to be operated in parallel, it is immaterial whether the high or low tension switches are closed first. If bare, high-tension buses are located directly over the air disconnecting switches, it is probably best in cutting a bank out to open the high-tension air switches first, as the other bank of transformers will take the load and there will result only a very small and harmless arc; the excitation current is then broken in the low-tension oil switch. If the low-tension switches are opened first, the exciting current will have to be broken by the air switches, and there will result a long arc, which, however, will do no damage except in case the buses are directly over it, when the fumes may start an arc between the buses.

Groups of Incandescent Lamps Used as Constant Resistors.

By A. C. Stevens.

In many electrical tests it is desirable to have a non-inductive resistor that is not only capable of carrying a considerable current, but which also has a temperature-resistance coefficient small enough to make the resistance practically constant over somewhat wide ranges of current. The advent of incandescent lamps with metallic filaments suggests a convenient means of securing both these advantages.

The resistance of the ordinary carbon-filament lamp decreases as the applied voltage is increased. This decrease is not so marked with voltages not far from that rated for the lamp, as at half voltage and less, where the negative temperature-resistance coefficient increases very rapidly. Filaments of the newer types have a positive temperature-resistance coefficient. The problem becomes that of combining lamps of the two classes in parallel to obtain a resistor having a constant resistance over a considerable range of voltage.

The writer has completed a series of tests with 110-volt lamps of the following types: 16-cp and 32-cp carbon-filament, 16-cp graphitized-filament, and 24-cp tantalum. Tungsten filaments as made at present are too fragile to be suited to this sort of work.

Simultaneous values of current and voltage were obtained for one or more lamps of each type by means of a potentiometer and standard voltmeter, the current being taken from a storage battery. From these values curves were drawn representing the relation between conductances (reciprocals of resistances) and applied volts. Representative curves are shown in Fig. 1, in which C is the curve for a carbon-filament, G for the graphitized-filament, and T for the tantalum-filament lamp. From these curves the best grouping of lamps for any desired range of voltage can be computed.

It is readily seen that the slope of the curve for the graphitized filament is more marked than that for the ordinary carbon filament. Hence, more than one carbon lamp must be employed to compensate for one graphitized-filament lamp. This is done by combining in ratios other than 1-to-1. The approximate ratio can be determined by a mere inspection of the curves,

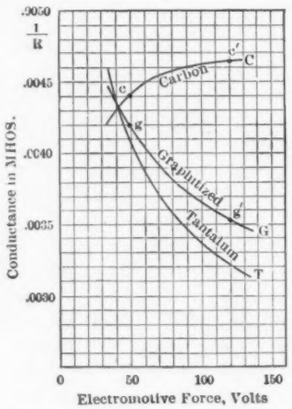


FIG. 1.—CONDUCTANCE CURVES OF LAMPS.

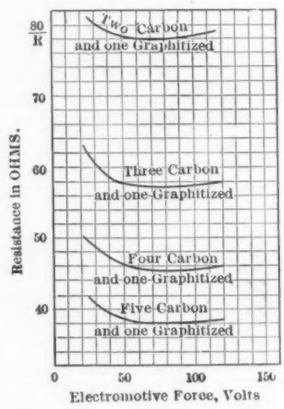


FIG. 2.—CURVES OF RESULTANT RESISTANCE OF VARIOUS COMBINATIONS OF CARBON WITH GRAPHITIZED-FILAMENT LAMPS.

yet it may be well to give a more exact method of calculating this ratio.

Over any range desired, consider the curves straight lines passing through the limiting points. This line will coincide with the true curve in only two points, yet as one curve is concave upward and the other concave downward, the curves will tend to balance each other and compensate for this error. Suppose it is desired to combine carbon-filament with graphitized lamps for a constant resistance when used at e.m.fs. between 50 and 120 volts. Let the conductances at the limits considered (Fig. 1) be c and c' for carbon, m and m' for graphitized filament.

Let a = number of carbon-filament lamps,

b = number of graphitized-filament lamps.

Equating the combined conductances at the limits taken

$$ac + bg = ac' + bg'.$$

$$\text{Solving, } \frac{a}{b} = \frac{g - g'}{c' - c}.$$

Substituting the values taken from the diagram,

$$\frac{a}{b} = \frac{41.8 - 35.3}{46.4 - 44.2} = \frac{6.5}{2.2} = \frac{2.95}{1} \text{ or say } \frac{3}{1}$$

Again, between 70 and 120 volts, by a similar computation,

$$\frac{a}{b} = \frac{5}{1}.$$

Between 35 and 120 volts the ratio is about $\frac{2}{1}$.

The greater the range considered, the less the ratio, yet the

greater is the variation of conductances between the limiting positions, due to the marked decrease in the conductance of the carbon filament at low voltage. Fig. 2 gives the results of tests made with various combinations of lamps. Resultant resistances are here shown rather than conductances. The curves show very plainly the usefulness of the method. Ratio $2 \div 1$ gives over no part of the range as constant a resistance as the $(5 \div 1)$ ratio, yet between 115 and 35 volts the extreme variation from the mean is less than 1 per cent. This agrees with the theory. With the $5 \div 1$ ratio the resistance at 120 volts is again reached at 60 volts. The range of voltage is less, yet the variation between the limits is only about 0.3 per cent. This is not quite as close an agreement with theory as the other ratios considered, for the resistance is nearly constant over a greater range than that calculated. A reason for this probably lies in the fact that there are differences in the individual lamps. While it was found that each type varied somewhat from one lamp to another, yet for most purposes any lamp may be considered sufficiently representative of the type.

When tantalum lamps were tried similar results obtained. The slope of the tantalum curve being greater than that of the graphitized carbon, in general more carbon lamps must be combined with one tantalum than with one graphitized lamp.

The study of the curves of Fig. 2 shows that even within wide limits, easily and without great expense, a resistor can be obtained with small temperature-resistance coefficient. For ordinary work it is necessary merely to insure that there are in circuit from two to five times as many carbon as graphitized or tantalum lamps.

If desired, lamps may be combined in series to afford a constant high resistance. In this case use should be made of a formula involving resistances instead of conductances. It was shown by experiment that a tantalum lamp in series with a carbon lamp afforded a resistance that decreased with decrease in the voltage. With two carbon lamps in series with one tantalum the resistance increased with decrease in voltage. One carbon and one graphitized-filament lamp in series gave the best result; the variation from the mean being about 1 per cent. Thus resistors of constant high resistance of small current-carrying capacity can readily be obtained for high voltage work, or for connection in series with the moving member of an electro-dynamometer or wattmeter.

A Convenient Experimental Transformer.

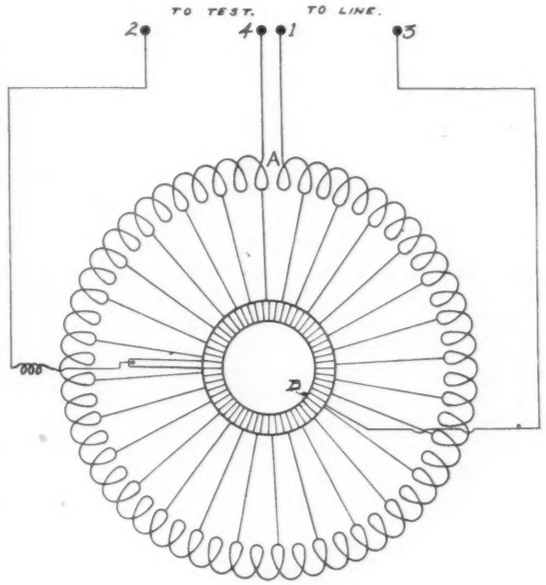
BY GEORGE T. HANCHETT.

The testing laboratory is a place of expedients. The work that it is called upon to perform varies widely, and the frequency of its recurrence does not always justify the purchase of special apparatus. In such institutions, therefore, methods to employ the means at hand are always acceptable, and for this reason the following simple plan of making a transformer of variable voltage out of what is often classed as "junk" is presented. The pièce de resistance of this device is an old Gramme ring armature. In the early days the Gramme ring armature was very popular, and as it was a moderately rugged device, almost every second-hand shop is likely to have more or less of them on hand of various sizes. Ventilator fans, ceiling fans, constant current arc light armatures—any one of these may be selected and some sort of a result obtained. If the bearing and brush-holder rigging of the machine is still in existence, this will be found to be a useful adjunct.

The first step in the conversion of the device is to cut out every other bar of the ring by disconnecting it from the armature, cutting off the loose ends, soldering them together and taping them up. The second is to open the armature circuit at a point, and bring out the leads to two binding posts mounted on a suitable panel. The third is to select a bar such as *B* in the diagram shown herewith and bring that out to a third binding post also mounted on the panel. Next remove one brush-holder, and equip the other with a gauze brush the width of one bar, and by means of a flexible terminal bring that out also to a fourth binding post on the panel. The work is then complete.

It will readily be seen that if a constant voltage be applied to binding posts 1 and 3, a variable voltage may be obtained from the posts 1 and 4 by the simple device of swinging the brush-holder and its brush around the commutator. The maximum voltage of this variable voltage will, of course, depend upon the location of the bar *B* and the applied voltage, and the increment of variation will depend upon this and the number of commutator bars.

The selection of the position of the bar *B* can, of course, be readily determined by those skilled in the art of designing transformers with a knowledge of the number of turns per section, the number of sections, the area, and the length of the magnetic circuit. As it often happens, however, that those who have to use devices of this kind are not able to make transformer calculations, a simple experimental method will probably be of assistance. To do this, construct a transformer as above described, omitting the connection of the bar *B*, and connect the available constant potential to binding posts 1 and 2,



CONVENIENT EXPERIMENTAL TRANSFORMER.

being careful that the brush rests upon the bar leading to binding post 4. As the brush is now advanced around the circle of the commutator the turns to which the applied voltage is applied will become less and less and the magnetizing current greater and greater. Presently a point will be found at which the iron in the armature begins to hum, and beyond this point it is not advisable to go if the transformer is likely to be on duty for any period of time; and this point should be selected as the proper point to connect bar *B*. If the brush be advanced beyond this point, the iron will hum still more loudly, and still further advance will result in the heating up of the coils which are connected in the circuit; and if the bar *B* be located at such a point as this, the result will be a much greater heating of the transformer connected up for service and required to carry load but the range of voltage to be obtained will be materially increased. For this reason it is well to select this point with a view to the purpose for which the transformer is to be put. If for temporary work, using only voltmeter currents and very light demands for current, the position of the bar *B* may be chosen much nearer binding post No. 1 than if the device is to be used for drawing considerable quantities of current. As the absolute character of the armature cannot be determined before hand, no more definite general experimental rule can be laid down. It is wise to remember, however, that the size of the armature wire is not alone a measure of the continuous capacity of the apparatus. That portion of the wire connected between

binding post No. 1 and bar *B* must in some cases carry both the input and the output current. The efficiency of such a transformer may be figured for practical purposes at about 75 so that the desired output watts being known and the input voltage, the current in the part of the transformer doing double duty can be calculated and kept within the limits.

The apparatus is convenient in repair shops where only one operating voltage is available, and where motors of various voltages are often repaired and required to be tested. It is very much better ventilated than the ordinary transformer and will stand a great deal of temporary abuse.

It will be found wise as a measure of precaution to remove the band wires on the armature, if there be any, for they are a possible source of needless eddy currents, and it will also be well to turn the commutator and thoroughly inspect its ends for dust and short-circuits, for the voltage between the bars will probably be considerably higher at times than that obtained when the armature was performing its old direct-current duty.

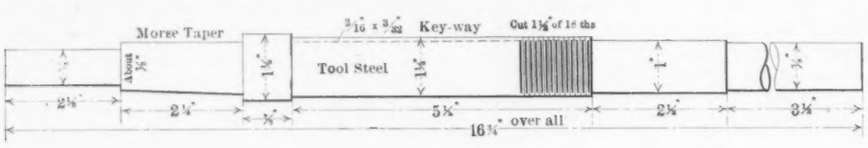


FIG. 3.—DETAILS OF SHAFT.

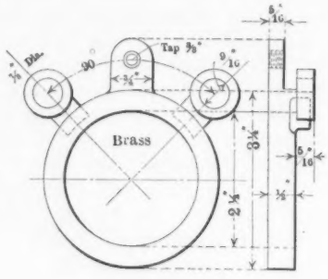


FIG. 4.—BRUSH YOKE.

Design for a 1-hp Shunt-Wound Motor.

By F. C. Mason.

As it is not usually possible to obtain the working drawings and complete data of commercial motors, working drawings and data on a 1-hp shunt-wound, direct-current motor will probably be of interest. Many motors have been built according to the design data given herewith, and these have proved to be cool running and efficient machines.

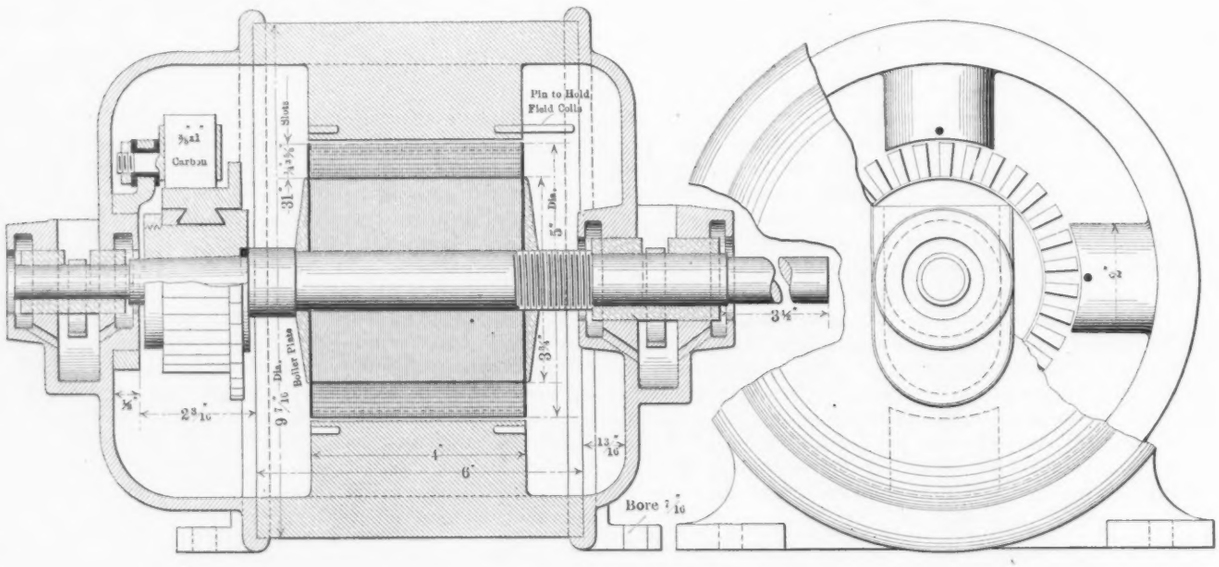
Figs. 1 and 2 show side and end elevations, respectively, of an assembled machine of the enclosed type. Figs. 9 and 10 illustrate an open type of bonnet for the commutator end. For the pulley side bonnet the same pattern may be used as is used for the enclosed type of motor, eight 1¼-in. holes being afterward bored through the sides of the bonnet. The field structure and bonnets of the machine are intended to be made of cast iron, which is easily obtained by the amateur, and is easy to machine, although the motor with a cast-iron field structure does not develop nearly so much power as one having a steel field structure, size for size. Cast iron, however, will answer for the purpose of the design. If the motor is built with a steel field structure and the winding of both the armature and field coils changed to take advantage of this superior construction, the motor will develop 50 per cent more power.

In finishing the field structure the casting is placed in a chuck and a 5⅛-in. boring made for the armature. One side is also faced at the same time for the bonnet. The outside of the yoke is turned off to a diameter of 9 7/16 in. and as close up to the chuck as possible. The casting may then be reversed in the chuck and the other end turned so as to true up exactly with the part already finished.

After the boring operations have been completed the pole-piece corners should be filed off to a radius of about 1-16 in. so as to provide rounded corners. The bonnets may then be placed in a chuck, bored for the bearing bushing, and given rough turned for the field frame fit. It may then be placed on a true mandrel and finished to size.

The greater part of the work of building a motor is in the armature, particularly in making the disks which compose the core. These may be made of either charcoal iron or electrical steel. The thickness of the plate may vary from No. 20 to No. 30 gage, and should preferably be about No. 28 gage. If it is not possible to get the disks made to specifications by punching they may be made in the following manner: The stock should be cut into 5¼-in. squares and enough of the material clamped together to give the required breadth, after which the iron may be bored and reamed for the shaft.

The disks should be clamped between two pieces of boiler plate in order to keep them flat and also to prevent the drill from tearing them to pieces when the boring operations are

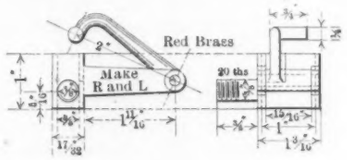


FIGS. 1 AND 2.—SIDE AND END ELEVATIONS OF MOTOR.

started. A collar mandrel 5 in. in diameter, with a nut on one end to draw the collars and disks together, should be used for clamping the disks, after which they may be turned down to size.

Thirty-one slots should be milled or planed in the periphery of the disks, and the slots should be ¼ in. wide by ⅝ in. deep. If the disks are well clamped together no burrs will result from the milling. If, however, burrs do result they should be removed. After taking the disks from the mandrel they should be washed in potash or gasoline to remove all traces of oil, and then shellacked on each side and dried. In the engraving the disks are shown key-seated. This, however, is not necessary, but facilitates assembling.

The shaft is shown in detail in Fig. 3. This may be made of



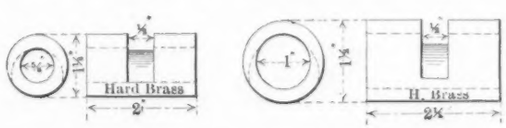
FIGS. 5 AND 6.—BRUSH HOLDER.

machine steel, tool steel or any other suitable material, but the writer prefers tool steel. It is advisable first to rough-turn the shaft and to finish it only where the disks go on. The headers for clamping the disks may be made of boiler plate. When assembling the core, fiber disks 1/16 in. thick should be placed on each end between the header and the metal disks, and, being of the same diameter, these may be turned out at the same time as the metal disks. In assembling the disks the slots may be kept parallel by inserting a piece of ¼-in. material in one slot. The core may then be screwed up tight, heated slightly and then be allowed to cool. The heating serves to set the shellac and freeze it to the shaft so that there will be no possibility of the core moving while the armature is under torque, even without the key. When the armature core has cooled sufficiently the turning down of the shaft may be completed.

Fig. 11 shows a section view of the commutator. The bushing may be made of cast iron or brass. The copper segments for the commutator must be absolutely insulated from each other as well as from the bushing or shell. If it is not desirable to build the commutator a complete commutator may be purchased. There are two kinds of micanite used for commutators; the harder grade is used for insulating the copper segments and the semi-flexible grade for making the washers and rings for insulating the segments from the shell. The semi-flexible micanite is made in sheets and does not differ in appearance from the hard micanite. By applying heat, however, it can be formed into the required shapes by using the shell for the mold.

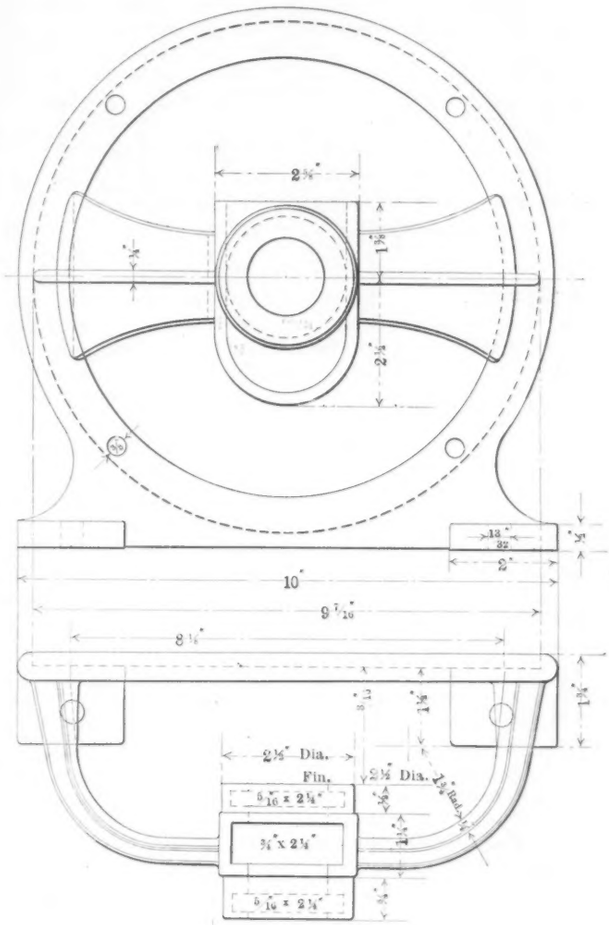
In assembling the copper segments a machine-steel ring about 4½ in. inside diameter by 5½ in. outside diameter and 1½ in. wide, with as many set screws as can be conveniently placed on it should be used. Thirty-one pieces of hard micanite 1¼ in. by 1¾ in. will be necessary, and this micanite should preferably be 1-32 in. thick. The copper segments and micanite should be assembled inside the ring, each ring and segment being shellacked and forced together with the set screws, care being exercised to keep the commutator circular by repeated calipering.

When the assembling of the commutator is completed it



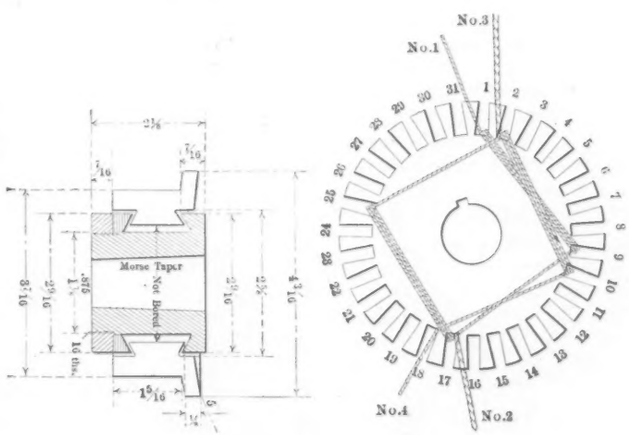
FIGS. 7 AND 8.—BUSHINGS.

should be baked until the shellac becomes hard. After baking the commutator should be placed in a lathe and the inside finished to fit the shell, as shown in Fig. 11. The micanite used to insulate the commutator segments from the shell should be 1-16 in. thick and should be carefully fitted in. The whole may then be tightened together by the nut and the end of the shell. The ring may now be removed from the outside of the commutator, and the commutator given a rough turn. A slot 1/32



FIGS. 9 AND 10.—OPEN TYPE OF BONNET.

in. wide by ⅛ in. deep should be sawed in the ear of each commutating segment for the reception of the armature coil terminals. The winding specified for the armature will give

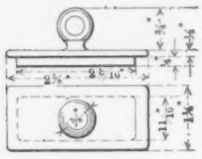


FIGS 11 AND 12.—COMMUTATOR AND ARMATURE WINDING DIAGRAM.

the machine a speed of 1200 r.p.m. at 115 volts. If connected to a 220-volt circuit the speed will be about 2000 r.p.m.

Although the armature could easily be fitted with form-wound coils, the amateur will probably find it easier to wind

the wire directly on the core. Before inserting the wires each slot should be insulated with a trough of flexible micanite or hard fibre 1-64 in. thick. For 110-volt service the fibre insulation is ample; but if the motor is intended to operate on 220-volt circuits the mica should be used. The slots when completely wound will contain 50 wires each of No. 21 double cotton-



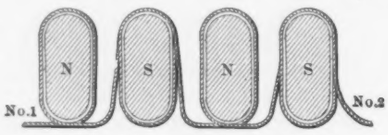


FIG. 13.—COVER FOR OIL WELL. FIG. 14.—DEVELOPMENT OF FIELD COILS.

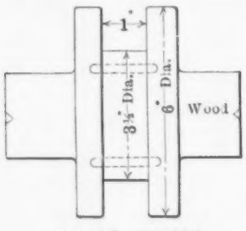
covered magnet wire. Fig. 12 gives a schematic winding diagram. Small pieces of oiled linen should be placed around the teeth between the slots, in order to protect the insulation on the wire from rupture. Starting at slot No. 1, wind to slot No. 9, 25 turns of wire, bringing the terminal across to slot No. 17 and carrying out a twisted loop for terminal No. 2. Then wind from slot No. 17 to slot No. 25, 25 turns of wire, bringing the terminal up to slot No. 2 and twisting a loop, as before, for terminal No. 3. Next wind from slot No. 2 to slot No. 10 in like manner, bringing terminal No. 4 out at slot No. 18, and so on. Place under all layers of wire, or where one layer crosses another, a piece of thin cotton or oiled linen. Continuing the winding as described, when the 50 turns are in each slot, the last terminal will connect with terminal No. 1. This gives a continuous winding, with no chance whatever for the connections being wrong when the winding operations are finished.

When the armature is completely wound three bands of retaining wire should be placed around the core. The bands may be made of No. 24 hard brass wire and should be wound on a thin layer of mica, in order to insulate them from the core and winding. These bands are intended to keep the coils in place when the machine is in operation.

The commutator should be provided with a pin key, in order to prevent any possible chance of its moving. The segments should be parallel with the slots in the core, and the armature terminals brought out straight and soldered in the ears of the commutator segments. Good solder should be used, and the soldering copper should be hot enough to cause the solder to flow freely so as to produce a first-class joint between the segments and terminals.

Fig. 15 shows a wooden bobbin for convenience in winding the four field coils. The coils should be wound with exactly 1200 turns of No. 25 single cotton-covered magnet wire, in order to obtain the best results. Common lamp cord may be used for the terminals, a soldered and taped connection being employed. The field coil may then be wound with one layer of cotton tape and then formed to fit the poles, after which another layer of tape may be applied.

Fig. 14 shows a development of the field coils and illustrates the method of connecting the coils together, so that no further



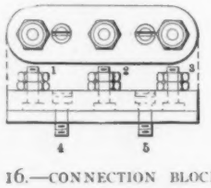


FIG. 15.—BOBBIN. FIG. 16.—CONNECTION BLOCK.

explanation is necessary. The bearing should be made of phosphor bronze, bored and rough-turned. Each bearing may then be placed in a chuck eccentrically and a cut taken for the oil rings. A half-round groove should be cut in the bottom side of the bearing for the oil pocket. The outside of the bearing may then be finished to an easy driving fit in the bonnets.

Fig. 4 shows the brush yoke, which may be made of cast iron or brass, but preferably of the latter material. The yoke shown is intended for a motor of the enclosed type. The ear in the middle at the top is provided for locking the yoke to the bonnet after it has been set in its proper position. For a motor of the open type this ear may be cut off and a 5-16-in. set screw substituted for the purpose of locking the brush yoke to the hub of the bonnet on which it is placed.

Figs. 5 and 6 show the brush holder. The holder may be made of brass, and right and left patterns should be made. The arm for holding the brush against the commutator should be provided with a coil spring around its hub, one end of which is connected to the arm and the other end to the brush holder proper.

Fig. 16 shows a connection block, which may be placed on the field structure or bonnet. The screws 1, 2 and 3 are for the terminals, and the screws 4 and 5 are for the purpose of fastening the block to the frame. Connect terminal No. 1 of the field coils and the lead from one brush holder to binding post No. 1. Field terminal No. 2 should be connected to binding post No. 2, and the lead from the remaining brush holder should be connected to binding post No. 3. These three permanent connections should all be made under the nut next to the fibre. The outside nut is for the purpose of providing a terminal for the line and starting box. The connecting blocks should be made of hard fibre, and brass screws should be used, as steel screws corrode easily and make a very poor electrical connection. All the necessary dimensions for building the motor are given on the drawings.

A Device for Improving the Voltage Regulation on Combined Lighting and Power Circuits.

By A. T. Kasley.

The average small plant consists of one or more steam or gas engines driving compound-wound, direct-current generators. When a motor or an elevator is thrown on the circuit the voltage drops for two reasons. The first one is that the field strength cannot be instantly increased to make up for the armature resistance and armature reaction losses. The current in the series coils of course must vary as the load changes, but an increase in the number of magnetic lines cannot take place without their cutting the coils of the shunt field and producing in them a back e.m.f. which on account of the great number of turns is very high. So high will it be that the shunt field will be momentarily decreased almost as many ampere turns as the series field increases. Some machines have their coils wound on metal spools which makes the effect still worse.

While the voltage is suffering from the effects of the increased load on the dynamo the engine speed will also be changing. Even in engines provided with "inertia" governors a sudden increase of load from zero to full load will cause a drop found by experience to be seldom less than 3 per cent and usually as great as 5 per cent. In a second or two the governor will have "recovered" a part of this drop and will reach a uniform speed from 1 to 3 per cent lower than at first. By this time the field will have built up to its proper value and the voltage will be normal.

It is the usual custom to build generators of standard design having a liberal number of turns in the series field coils and adjust them to suit conditions by putting a shunt of german silver, etc., across the series field terminals which by-passes part of the current. Now, if this shunt be replaced by a choke coil having the same ohmic resistance as the shunt and a self induction somewhat greater than the series field coils, the latter will for sudden increase in load be compelled to take a larger part of the current; thus to a greater or less extent preventing the drop in voltage and consequent wink in the lights. This arrangement has the advantage of having no moving parts and is not subject to much deterioration, which is the bane of

storage batteries. If a new installation is being planned it would be wise to specify that the generator shall contain a larger number of series turns than is usual.

For a trial of this kind of apparatus the engineer can usually borrow a transformer whose low tension coils are heavy enough to carry the maximum current. Their resistance should be approximately equal to that of the shunt.

It will be plain that for slow changes of load this apparatus will act as if it were only a plain resistance shunt and will therefore not raise the voltage above what it should be.

Determining the Electromotive Force of a Dynomo Without Running It.

By W. M. HOLLIS.

Sometimes it may be desired to obtain the electromotive force of a certain dynamo and for some reason the means for driving it may not be at hand. Given the speed in revolutions per minute and a spring balance or, for a large machine, some form of a portable platform scales, the e.m.f. may be readily obtained. Some preliminary adjustments will doubtless have to be made in order to obtain convenient values of current for the spring balance or scales, and also to obtain a convenient length of lever arm.

First of all the direction of rotation of the machines should be found when connected to run as a motor. The field coils should be fed by a circuit separate from the armature and an ammeter placed in the armature circuit. A somewhat approximate idea of the full-load armature current for the machine may be obtained by inspection and a resistance capable of carrying current for some length of time without overheating should be inserted in the armature circuit.

The current used for the test may be the full-load current or only a fraction of it and the series armature resistance should be of a value to keep the current at such value. This resistance should also be adjustable within wide limits. A variable field resistance of known value should be employed or an ammeter should be placed in the separate field circuit so that the field current may be kept constant. The method involves the principle used in the well-known Prony brake test for obtaining the horse-power of a motor.

Some form of lever arm of suitable material, depending upon the size and position of the generator, should be firmly clamped or fastened to the pulley at one end of the shaft or in any other convenient manner if a pulley is not at hand. The lever may be attached to the outer edges of the pulley rim like a crank arm and the spring balance fastened to a cross-bar with its lower or measuring end fastened to the lever arm or crank arm so as to prevent the rotation of the shaft and to measure in pounds the pull of the lever arm. The size and strength of the lever of course depends entirely upon the size of the machine, though a piece of timber is preferable ordinarily.

When the adjustments are made to give convenient values of the armature current and the distance of the point of attachment of the spring balance on the lever arm from the center of the armature shaft is measured accurately in feet, the values may be substituted in the equation

$$E = (l\,S\,P) \div (7.04\,I)$$

where l is the distance in feet from the center of shaft on the lever arm to the point of attachment of the spring balance; S, the revolutions per minute of the armature at normal full-load; P, pull in pounds on the spring balance, and I, the current in the armature at the time. The field current should be kept constant, all the time. Of course, the direction of rotation of the machine when the current is switched on should be determined before the balance or scales are put in place, otherwise if the direction of rotation is wrong some damage may be done due to the whirling of the lever arm free, in the wrong direction.

As is well known, with the Prony brake method of using a lever arm and spring balance or scales the horse-power may be readily determined by the equation

$$Hp = (2\pi\,lSP) \div 33{,}000$$

where l, S, P have the same significance as before. With no losses in the machine

$$Hp = \frac{E\,1}{746} = \frac{2\pi\,l\,S\,P}{33{,}000} \text{ and } E = \frac{l\,S\,P}{7.04\,I}$$

The current in the field coils is not included in the test, and the current used in the armature should be as small as will give scale readings which may be read with some degree of accuracy. However, the armature current necessary to give good results should be the full load current.

Care should be used to have the bearings as well lubricated as possible in order that the armature may move freely. While readings are being taken on the spring balance the lever arm should be moved slightly, after an apparent balance is obtained, to increase the balance reading, and the balance should then return quite easily and quickly to its original reading. The freer the movement of the armature the better the results obtained.

Usually a good plan is to oscillate the armature by means of the lever arm slightly in each direction before the current is switched on in order to be sure that there is a free movement of the same.

The balance reading (if any) when no current is flowing should be taken by oscillating the lever arm slightly by hand, the mean reading taken and this value in pounds subtracted from the value when a pull is exerted with current flowing in the armature. If appreciable this pull is, of course, due to the unbalanced end of the lever arm weighing down the scale.

Now, the losses in a dynamo are the I^2R losses in the armature and the field coils, the friction losses and the core losses. The field coils are excited from a branch circuit not included in the test, which eliminates their I^2R loss. The armature is stationary, which eliminates the friction and the iron losses. If a large current valve is used in the test, the losses may be calculated and allowed for as a certain percentage of the full-load power of the machine. With all losses, say 15 per cent or with 85 per cent efficiency,

$$E = \left(\frac{l\,S\,P}{7.04\,I}\right) 1.15$$

Very likely several trial values with the corresponding calculations compared, or a method of cut and try, will have to be used unless the values of voltage and current are approximately known at first. In this case, however, the friction losses, the iron losses and the field coil I^2R losses are eliminated and the armature I^2R loss is usually only a small percentage of the whole loss.

Induced Draft.

By W. H. WAKEMAN.

When the draft in a steam boiler furnace is due to natural causes alone, it is generally weak when compared with what can be secured by artificial means, therefore although natural draft may give satisfactory results under certain conditions, there are many days each year in which it is barely possible to generate steam enough to operate certain plants owing to unfavorable surroundings. This causes the chief engineer much anxiety, for nothing is more disturbing to him than to see the pointers on his steam gages slowly but steadily moving backward, and while he knows that his firemen are putting forth their best efforts to remedy this undesirable state of affairs, he is not sure that they will have a measure of success that will enable him to keep the machinery in motion until noon gives a temporary respite in the demand for steam, enabling them to gain a few points, or until night puts an end to the labor and worry of the day.

For an illustration of this fact it is only necessary to visit a plant with which the writer is familiar, where it was impossible to make steam enough to run the engine when the wind blew in a certain direction, consequently whenever conditions prevailed that caused low pressure of the atmosphere in one direction from this plant, and air from the directly opposite

direction was rushing into this low pressure or partial vacuum area, this engine had to be shut down until the wind changed, causing much anxiety to the engineer and loss to the owners.

Of course, it was only a simple defect that caused this trouble, and when the owners had suffered the loss of enough money to pay for curing the evil several times over, they were ready to adopt the engineer's recommendation and have an improvement

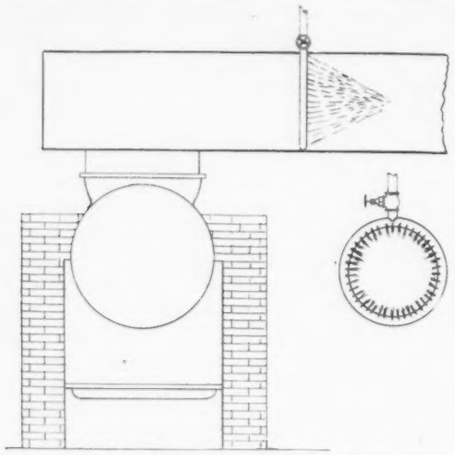


FIG. 1.—HOME-MADE DEVICE FOR CAUSING DRAFT.

made in the top of the chimney. When its shape was changed the trouble disappeared, and now they always have enough draft, although an inferior grade of fuel is burned.

The point to which attention should be called is that it only requires a slight change from normal conditions to reduce natural draft until it is insufficient for the desired purpose, or even to eliminate it altogether, therefore the addition in some cases and the substitution in others of a device for forcing circulation of air and hot gases up through the chimney is often desirable and sometimes necessary. Whenever artificial means of any kind are used to increase the speed at which the hot gases resulting from the combustion of coal (or other fuel) travel to the atmosphere, and the means employed are applied between the boilers and the vertical stack or chimney, the result is known as induced draft.

Fig. 1 represents a home-made device put into the smoke-pipe of a certain plant several years ago. It consists of a coil of pipe just large enough to be a loose fit in place, bored full of holes, as shown in the end view presented. These are on the proper angle to project the jets of steam, as shown in the side view. This device would force the air and hot gases along through the pipe more rapidly than natural draft would take them, causing a rush of air into the ash pits and increasing combustion in the furnaces; nevertheless, it was not a success, because it used too much steam. When the pressure was high enough to close the automatic damper regulator it could be used, but it was not wanted then. Later on the pressure would fall and the natural draft was not strong enough to restore it. If an attempt was made to use it then it took so much steam that the surplus over what could be made with natural draft all went to run the device, partly owing to the fact that it did not draw well with a low steam pressure. The chimney into which this smoke-pipe discharged was only 16 in. square at its smallest part, and 54 ft. high above the grates, yet it supplied draft for two tubular boilers of 50 hp each, rated on a basis of 15 sq. ft. of heating surface per horse-power. These boilers actually developed about 40 hp each. The chimney was originally built for a forge shop, but, owing to changes made in the business, the shop was discontinued and the boilers set near the chimney. It was considered hardly possible for this chimney to be sufficient for the service required, but a trial was given it and the result proved its value, as it supplied the required draft for many years.

Fig. 2 illustrates a device used to increase the draft of a brick chimney or an iron stack. It gives the best results when located in the vertical shaft just above the opening for the horizontal pipe. When placed in this position it decreases slightly the area of the shaft, and if this is objectionable it may be placed lower down, where it will be below the horizontal pipe, thus eliminating the above mentioned objection.

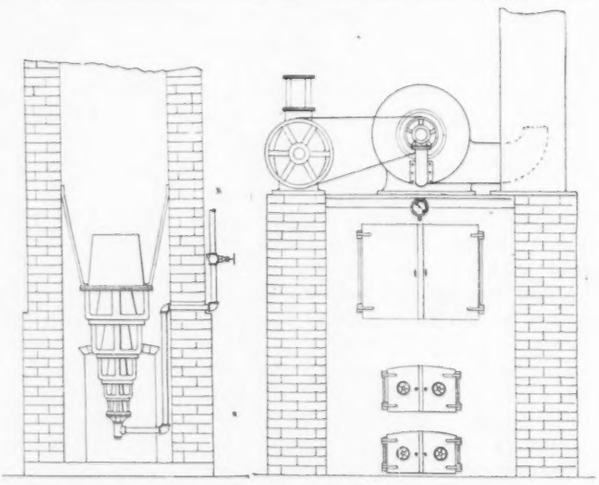
A comparatively small steam pipe is sufficient to operate it, because the device is designed to use steam to the best possible advantage. It consists of a series of nozzles, one above another, of gradually increasing area, and as steam under high pressure is introduced at the bottom through the pipe shown, it expands and, rushing upward at great velocity, sends the products of combustion to the top of the chimney. Dry steam only should be used, and the pipe ought to be covered with a good non-conductor of heat, in order to keep it so, otherwise the velocity of steam may be retarded if the jet contains slugs of water.

A device of this kind is not generally used in a new chimney, as it is supposed to be made large and high enough to give the required draft, but unforeseen conditions may arise in an old plant, making it necessary to do something at once to correct the effect of undesirable conditions. For illustration of this idea take the case of a low brick chimney standing a long distance from other buildings except the boiler house to which it belongs and the mill for which the boilers supply power. On the adjoining lot a brick factory is built that towers two stories above the brick chimney, and, although it is known that this building is to be erected, nothing is done about it until the low chimney does not give enough draft. The required steam pressure cannot be maintained, and consequently the engine is shut down, causing loss of time and interruption of business. In this emergency the draft improver, shown in Fig. 2, is purchased and installed, and it does good work in making it possible to maintain the usual steam pressure.

It is customary for marine engineers in charge of small boats to connect a steam pipe into the stack above the boiler and thus create a strong draft for use in emergencies. The end of this steam pipe is tapered down to form a nozzle and thus give the steam jet maximum velocity, but even with this improvement it is a wasteful device. If the draft improver shown in Fig. 2 were installed in all such cases the results would be more satisfactory.

The following description of a plan made by a consulting engineer for improving the draft of a certain shop chimney is interesting and instructive. It was submitted to the writer for approval, but there seemed to be a good reason for rejecting it and it was not put into practical operation.

Fig. 3 illustrates one of the boilers in this plant equipped with



FIGS. 2 AND 3.—METHODS FOR CAUSING INDUCED DRAFT.

a blower that is driven by an independent engine mounted on one of the side walls. The blower is placed on light girders, which rest on both walls of the setting. The objects in locating this appliance here are to save floor space and to avoid the use of long air pipes. Air was to be blown into the chimney, and as it would be forced upward by the blower it would draw the products of combustion after it and thus create a strong draft.

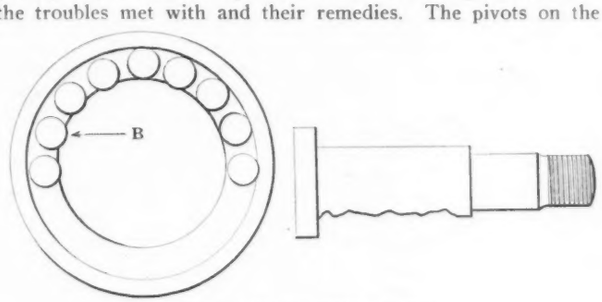
The objection to this plan is that, inasmuch as the chimney is much too small for the volume of gases that ought to be discharged, it seems inconsistent to use a blower and deliver an additional volume of air into the chimney, especially as this is cold air, which will not tend to rise like heated air. Even if tests should show that it is heated by the process, it only robs the products of combustion of a portion of their natural heat, hence reduces their tendency to rise. Furthermore, while the volume of air delivered by such a blower is an extra load for the chimney, it expands when heated and thus occupies more space than it does when cold, making it still more objectionable. A system of forced draft was installed for temporary use until a larger stack was erected.

Some Shaft Governor Troubles.

BY C. R. MCGAHEY.

While all of the machinery in a power plant is apt to give more or less trouble at times, there are conditions into which the centrifugal shaft governor can fall out of which it is a hard task to get it. The source of most of the trouble of the governor is the pivot or bearing upon which the main part of the governor swings. These pivots have been made in various ways with many kinds of anti-friction schemes to prevent trouble, and in some cases the results are worse by far than the plain bearing. In some governors on the market the whole pressure is upon one side of the bearing and this has a tendency to cut off the lubrication from that side and increase the friction, and a pivot designed to work under a certain load distributed over so many square inches of surface is certainly not working under best conditions when the total friction and pressure fall on one side.

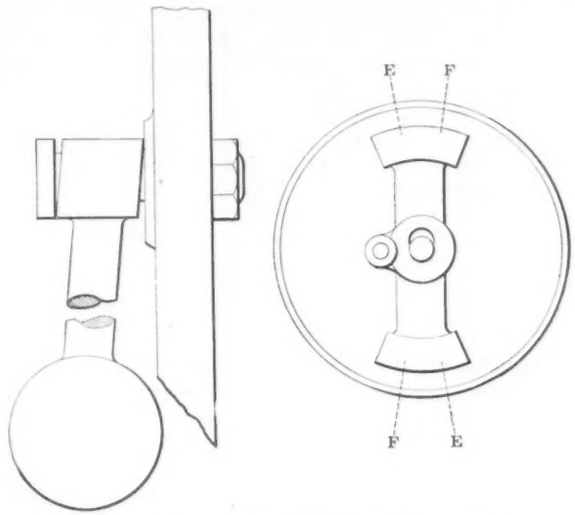
In this article no attention will be given to the design of pivots, etc., but an attempt will be made to bring out some of the troubles met with and their remedies. The pivots on the



FIGS. 1 AND 2.—WORN PIVOTS.

small arms of many governors are found in the condition indicated by Fig. 2 and the man in charge may oil the governor, giving it, in fact, a kind of shower bath, but the oil does not reach the working surface. Consequently the pin soon becomes badly cut and the result is a greater friction than before, causing a sticking of the governor which holds on until a speed high enough to throw the weight out is reached. The steam is then cut off suddenly and the speed is reduced, when the weight drops back and the engine races again. In many installations the writer has seen the bearing surface actually rusted and corroded from lack of proper lubrication, the oil never reaching the surface intended.

Some governors are hard to handle successfully, since because of peculiar design great stress is brought to bear on one side of the working pivot and it is a good plan to take these apart and clean the oil rings once or twice a year. Fig. 1 shows a common style of governor pivot that has and will give any amount of trouble, having a steel pin, a steel bushing and a set of hard steel rollers. When new, the regulation of this governor is good, but after a while the governor begins to be a source of worry. Upon examining the bearing it is not unusual to find the rollers embedded in the pin as shown. This condition is due to the constant oscillation of the governor. In order to make this clear, the common line of oscillation of the governor in Fig. 4 is shown. The point on line *E* will swing to the point *F* and will keep this up while the engine is running, so that one can see why the rollers will form a bed for themselves and soon make a poor working governor out of what was otherwise a good device. The governor will hang and lose sensitiveness. The writer has found that by renewing the pivots with a good bushing made of Lumen bearing metal that the governor would give no further trouble. It is doubt-



FIGS. 3 AND 4.—OSCILLATING GOVERNOR WEIGHT.

ful if the friction rollers serve any useful purpose, since they soon grip the pivot and prevent the free action of the governor. In making the pivots it is essential to have good oil grooves to permit the free passage of oil.

Fig. 3 shows an exaggerated position of a governor weight. Such conditions are by no means uncommon and the result is that the governor sticks and the speed increases. In some cases the spring is mounted in such a way that the weighted arms swing out of line with the working parts, causing the engine to slow down. By installing new pins and bushings for the working parts the governor can be made to operate nicely and regulate the speed of the engine within a few per cent.

The governor in some cases may be doing its part and the regulation be defective because there is so much lost motion in the valve gear. In Fig. 5, for instance, the lines *C* and *D* show just how some valve gears work. The valve does not respond to the movement of the governor because of lost motion between the governor and the valve. The play of many valve gears can be easily taken up and the engine made to give excellent service. Governors are rather delicate pieces of apparatus and the valve gear should be kept in the best condition possible if good results are to be obtained. It is a known fact that shaft governors will cause slight racing when the springs and weight are too nicely adjusted. By adding a small

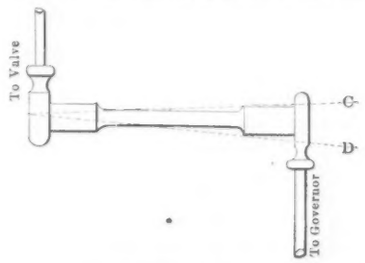


FIG. 5.—LOST MOTION IN VALVE GEAR.

weight or by decreasing the tension on the spring, the governor will cause the engine to give a much steadier speed. The writer has equalized the tension of two springs by striking them with a small hammer and changing the tension of one until the sound emitted when striking both springs was the same. The one-spring governors are more easily adjusted than the older types having a number of springs.

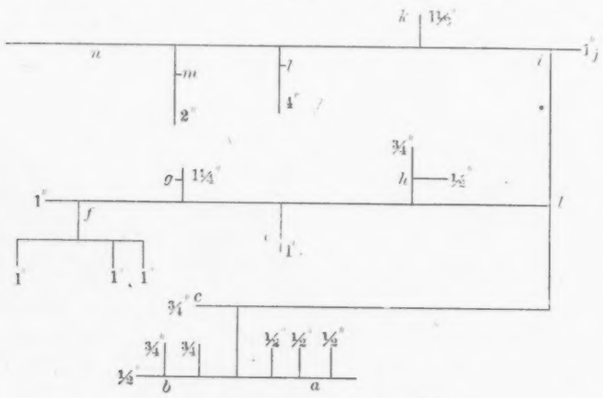
LETTERS ON PRACTICAL SUBJECTS

CALCULATING PIPE DIAMETERS.

A case of improper arrangement of pipe diameters recently came to the attention of the writer, several steam pipes in a central station being fitted with branches and outlets which called for more area than was possessed by the pipe supplying the outlets in question. The rule-of-thumb method of some pipe fitters—and some engineers as well—of working to the squares of the diameters of the various branches, while close enough under certain conditions, is not of sufficient accuracy for use when the limit of pipe cost is to be worked for.

For instance, the pipe fitter says: "I have a 3-in. pipe and a 4-in. pipe to serve. What diameter of pipe shall be used for connection with the boiler?" Furthermore, the pipe fitter calculates: "Three x 3 = 9, and 4 x 4 = 16; and 9 + 16 = 25. The square root of 25 = 5, which is the diameter of the connecting pipe required." Thus far the method works well enough, but presently the pipe fitter desires to know what size supply pipe will be required to furnish steam to 25 1-in. pipes in a heating coil. The same rule is applied.

Undoubtedly, a 5-in. pipe would do the work, for the reason that steam hardly ever travels at full velocity in heating pipes, and a trifle of increase of velocity in the 5-in. pipe would supply the demand for steam. But the size is not quite right, for the reason that the area of a 1-in. pipe is not that of a 1-in. circle.



CALCULATION OF PIPE DIAMETERS.

The 1-in. pipe is actually 1.048 in. inside diameter and has an area of .861 sq. in., against .7854, the area of a 1-in. circle. The area of 25 1-in. pipes is 25 x .861 sq. in., while the area of a 5-in. pipe is only 19.635 sq. in., and a 6-in. pipe should be used to obtain full equal area of pipe opening. The 5-in. pipe will then actually equal in area 19.635 ÷ .861 = 22.8; therefore, the 5-in. pipe will actually supply 22.8 or 23 1-in. pipes instead of 25 as by the rule-of-thumb calculation.

When figuring the smaller sizes of pipes the diameter rule fails to make good, as the actual diameters of small pipes run far ahead of the nominal diameters. Thus, in laying out a pipe system the diameters of main pipes should be computed from their actual areas, not from their nominal diameters. Let the engraving herewith represent the openings to a lot of pipes for which it is required to calculate the diameters of the supply pipes, *u*, *i*, *d*, etc. First, take from a pipe table the areas of all the pipes likely to be required in the diagram, as follows:

½ = .304	1¼ = 2.036	3½ = 9.887
¾ = .533	2 = 3.356	4 = 12.37
1 = .861	2½ = 4.78	4½ = 15.961
1¼ = 1.496	3 = 7.383	5 = 19.987

Next, take the group of pipes the farthest away, say at *a*, and ascertain the joint area, which is 3 x .304 = .912. It would pinch a little to connect these three pipes to a 1-in. pipe with .861 sq. in. area, but it would perhaps be done by the pipe fitter who would claim that probably all three of the pipes at *a* would not be in full use at the same time. This may work in many cases, but in these calculations we will carry it up to the next larger size and put in a 1¼-in. pipe from the first ½-in. pipe to the junction with pipe *b*.

Connected with pipe *b* are two ¾-in. pipes, with a joint area of 1.066 in.; also a ½-in. branch = .304 in., a total of 1.57 sq. in. This will require a 1¼-in. pipe also. The sum of the areas *a* and *b* is 2.284 sq. in. and require a 2-in. pipe. But the pipe area is large at this point, being 3.356 sq. in., against 2.284 required, hence the 2-in. pipe will also take care of the ¾-in. pipe at *c*, its .533 sq. in. of area bringing the required area up to 2.817, or still less than the capacity of the 2-in. pipe, which may be run to junction *d*, where it is necessary to stop and calculate the areas of the openings in branches *e*, *f*, *g*, *h*.

At *f* three 1-in. pipes aggregate an area of 2.583 in. and require another 2-in. pipe at *f*. But another 1-in. branch must be taken care of at this point, increasing the area to 3.444 in. and requiring a 2½-in. pipe, though some fitters would squeeze the three branches into a 2-in. pipe. But branch *g* requires 1.496 in. more, or 4.94 in. in all, and a 3-in. pipe will have to be put in, giving an area of 9.887 sq. in., which can be run along until the other branches take up the extra area. Branch *e*, 1 in., will use .861 sq. in. more, and the two openings at *h*, ¾ in. and ½ in., require .837 in. more, making a total of 6.638 to be added at *d* to the 2.817 sq. in. from *c*, making 9.455 sq. in. and calling for a 3½-in. pipe to *i*, where another 1-in. branch *j* comes in with an area of .861 in., making a total of 10.316 sq. in. and requiring a 4-in. pipe which has an area of 12.37 sq. in.

The 4-in. pipe will also take care of the 1½-in. pipe at *k*, with its 2.036 in. of area, giving a total of 12.352 sq. in., against 12.37 sq. in. for the 4-in. pipe. The branch at *l*, 4 in. in diameter, calls for 12.352 + 12.37 = 24.722 sq. in. of area, or a 6-in. pipe of 28.89 sq. in.; and the 6-in. pipe will be large enough to accommodate the additional 3.356 in. area of the 2-in. pipe at *m*, giving a grand total area of 28.087 sq. in. of pipe opening, fully covered by the 6-in. pipe.

When pipe sizes are calculated in this way there is little chance of the supply pipes proving too small. In case of additions to the pipe opening, if such additions are to be included in the original layout of the piping, the only way is to approximate the area and location of the additional openings and then allow for them exactly as if they were to be put in when the line is first erected.

In a case like this, it might be well to allow for another pipe line when additions are to be made, as the next larger pipe, 7 in., will add about 10 sq. in. of area, or about the equivalent of a 3½-in. pipe and it might be profitable to run a 1½-in. or 2-in. pipe direct from the boiler if it should be found at any time that a little more steam was needed for additions. Again, in many instances, the existing branches do not take steam to nearly their full capacity and many more square inches of branch openings can be taken from the supply pipes without materially reducing the pressure in any of the pipes.

It certainly is a very good investment of time, when laying out a system of piping, to figure carefully the branch areas as above and thus avoid the possibility of a very troublesome lack of pipe area which might happen were guesswork depended upon for the determination of pipe diameters.

Boston, Mass. S. V. Oliver.

PROPER FUSING OF THE PRIMARY CONNECTIONS OF TRANSFORMERS ON 2200-VOLT SYSTEMS.

The writer has been in charge of electric-light properties for the past 17 years, and during all that time has only noticed a very few articles that would tend to give the layman the slightest idea of the proper size of fuse to insert in the primary circuit of the transformer. It is generally recognized that one of the greatest losses that central stations feeding alternating-current systems suffer occurs in the transformers. The writer has found that in practice the chief loss of the transformer is due to two things: legitimate breakdown by lightning and carelessness on the part of the troublemen in not knowing, or not making an effort to know, the right size of fuse to insert in order properly to protect the primary windings.

Large companies give their workmen definite instructions to place certain sizes of fuse in each individual transformer primary fuse block, so that trouble from this source is minimized. The purpose of this letter, however, is to call the attention of smaller stations to this matter and to give the proper size of fuse to insert in the primary fuse box of 2200-volt transformers.

In order to make plain how vital this subject is to the maintenance of an interrupted service because of burnt-out transformers due to improper fusing of the primary circuits, an account of an experience the writer had with a single-phase system fed from a three-phase, four-wire system with 4400 volts between phases and 2200 volts between any phase and the neutral or ground, may be interesting. When the writer took charge of this system, there went with it a so-called good troubleman who had been in charge of the system for the two preceding years. This man's knowledge of the subject of fusing, I subsequently found out, was very little. The result was when we had a season of continued stormy weather with much lightning, this fact was made very noticeable by the great number of transformers that were being continually burnt out. Inasmuch as these transformers were manufactured by a company having no peers in this line, and also since the lines were protected by the best make of lightning arresters obtainable (the arresters being spaced about every 3000 ft.), investigation seemed necessary. The troubleman responsible for the fusing of the burnt-out transformers was interrogated as to the size of fuses he was in the habit of placing in the fuse boxes of various sizes of transformers. His reply indicated that he never paid any attention to the sizes of fuse wire, but put in a fuse that he knew would be large enough to hold. Of course, this answer immediately showed what was the matter with the transformers, and the writer immediately hired a horse and carriage and taking a lineman with him set out for a personal investigation of all the transformers on the line.

The first transformer inspected was rated at 2 kw, and in the primary fuse block there was a 10-amp fuse inserted. This was exactly 10 times larger than it should have been. Further investigation showed that a 10-amp fuse was about the standard size which the troubleman knew would be big enough to hold. There could be no doubt as to its holding power, since the usual result was that the transformer primary winding burned out instead of the fuse. In a 5-kw transformer a 20-amp fuse was used in the block. When we returned to the station and asked the troubleman why he inserted primary fuses in such a haphazard way, without any regard to the rating of the transformer or of the size of the fuse, we found that it was rather inconvenient for him at times to drive over the whole 18-mile line because of a little fuse when a bigger one would answer. Needless to state, we obtained another troubleman. This man was given a card with the sizes of the transformers and the sizes of fuse to place in the primary fuse box of each, as follows:

1,000-watt	transformer	.....	1-amp.	fuse.
1,500	"	"	.....	1	"	"
2,000	"	"	.....	1	"	"
2,500	"	"	.....	2	"	"
3,000	"	"	.....	2	"	"
4,000	"	"	.....	2	"	"
5,000	"	"	.....	3	"	"
7,500	"	"	.....	4	"	"
10,000	"	"	.....	5	"	"
15,000	"	"	.....	8	"	"
20,000	"	"	.....	10	"	"
30,000	"	"	.....	15	"	"

I find the above table of fuse ratings works very well in practice on a 2500-volt system. Approximately 1 amp of fuse capacity is allowed for each 2-kw rating of a transformer. On 1000-volt systems the values in the above table are doubled.

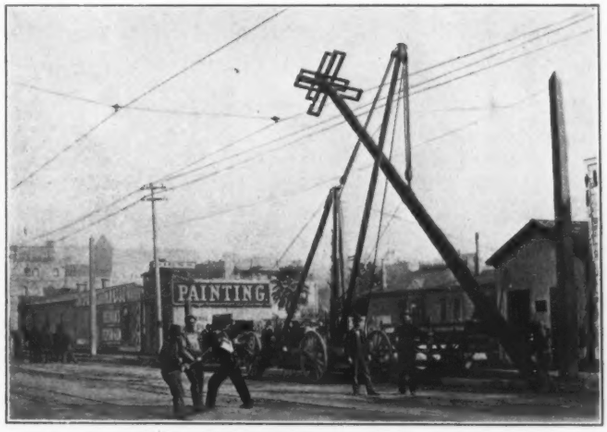
When a fuse is placed in the plug of a modern porcelain cutout, the troubleman is instructed to place a small quantity of red clay over the fuse where it makes the turn over the end of the plug in the groove. The reason for this is that the clay, being incombustible, dries in a few days and the fuse is enclosed securely in a small chamber. The result is when the fuse blows, a gas is generated in this chamber which quickly extinguishes the arc. Plaster of paris is also sometimes used, although it is preferable to use the red clay.

ST. LOUIS, MO. C. S. NEELEY.

POLE SETTING APPARATUS.

I note in the first issue of July a description of a pole setting apparatus invented by a Mr. Shafer. It is stated that the machine is operated by two linemen and one teamster; and there can be no doubt but what poles can be set much easier and cheaper in this way than by piking them into position. Accompaying this is the picture of a pole setting machine that I arranged for a contractor of Los Angeles, Cal., during the winter of 1897-1898. This machine was used in setting all the poles in the transmission line of the San Gabriel Electric Company, of Los Angeles, now controlled by the Pacific Light & Power Company. This line is 24 miles long, and 44 poles were used to the mile. In the country, 45-ft. poles were employed and in Los Angeles 65 and 70-ft. poles were erected. The derrick is shown in the act of raising a 74-ft. pole in position. The top of the pole is 14 in. in diameter, the butt 24 in. in diameter, and the pole was water-soaked at the time, having been taken out of the raft two days before. On the top there is a double buck-arm shown. The arms are of elm and the pole is used at the city end of the 24-mile transmission line. Four horses are shown raising the pole and the wagon is in no way guyed to keep it from being upset. Three men are shown holding the guy rope attached to the top of the boom so as to permit the pole to swing into place when it is completely raised.

A stone wagon was employed for this purpose and the uprights of the derrick are of 8 in. x 8 in. hard pine, hewn on the corners. The boom is of 8 in. x 8 in. material 20 ft. long, and



SETTING POLES IN LOS ANGELES, CAL.

8-in. blocks and 1¼-in. rope were used for the rigging. The tower was built so as to pass under trolley wires and the boom could be raised and lowered by one man with ease. The derrick was used daily by one teamster and one ground-man in setting poles in the country. In setting the poles the driver would drive up close to the hole, block the wagon, unhook the double tree, drop the tongue and the "grunt" would have the chain on the pole and the pole would be set in the hole with the cross arms on, ready for the tampers.

This machine made a record for itself by setting 86 45-ft. poles in 10 hours. Six tampers were needed to pack the ground securely around the poles. In doing the work it was not necessary for the poles to be close to the holes as the boom would swing around and pick up the pole in any position. The pole was held with a trip hook and a hand line was attached so as to pull the blocks down. The machine was used to unload the poles from the cars to the wagon and also to lift large reels of No. 5 bare copper wire on the reel wagon. It was also used to transfer poles along the line for the different grades. Two and three poles could be loaded on this derrick and unloaded by the two men with the assistance of the boom.

Ten bags of gravel ballast were used on the truck, since this could be easily transferred to either side of the wagon according on which side of the street the poles were being set. The illustration shows the heavy buck-arms and the exactness with

which they were fastened by the writer, who did all the gaining and cross-arming on every pole on the 24-mile line. This brief description may be of interest in connection with the one already referred to.

Chicago. Ill. H. C. Sharpe.

REPAIRS WITH HOME-MADE THERMIT.

Referring to the letter in the June number from Mr. F. W. Moore, in which a description is given of a method of making thermit repairs, the writer wishes to state that he has been experimenting with thermit in a small way since writing the letter which appeared in the May number and soon found that the cost of tools and materials was prohibitive for shop or station use. The thermit was purchased from a painter; that is, a quantity of powdered aluminum, and also a quantity of pure red oxide of iron as it comes from mixing "mineral" paint. The aluminum and the iron oxide were mixed in about equal proportions by weight, being passed through fine sieves and then shaken in a paper sack, the open end of which was held closed by the hand during the shaking operation. The bag method is the best known method of mixing small quantities of two or more dry ingredients.

My first experiment was the forming of a new shank upon a ¼-in. tap which had been broken off about 1 in. above the threads. A mold was made of silica sand and a little raw linseed oil with a pinch of rye meal added, although a handful of core mixture will answer very well. A mold was made up, open on top, and the broken tap enclosed with the broken end projecting into the mold. A crucible or "melting stage" was arranged just above the open mold and a bit of finely woven iron-wire cloth was used to ignite the home-made thermit. The holes in the wire cloth were closed by mixing a little of the thermit mixture with water and daubing the holes in the wire-cloth full of the plastic mixture. The daubed wire-cloth was supported on a wire ring just above the open mold and room was left between the ring and the mold for projecting into the mold the blast from a gasoline torch similar to that used by plumbers and painters. In fact, the blow-torch was started as soon as the mold was finished, and the blast was kept on all the time the thermit stage was being rigged. In 10 minutes the end of the tap began to show a red heat and the charge of thermit, about three times the estimated weight of the piece of steel to be formed, was placed loosely on the daubed-up wire-cloth stage. The blast was kept on until the thermit was ready for ignition, which was done by placing on top of it a pinch of magnesium powder, such as photographers use for making flashlights. A strip of thin paper was placed on the thermit and the magnesium paper placed on top of one end of the paper.

Just as the free end of the slip of paper was lighted, and the flame almost reached the magnesium powder, the blow-torch was snatched away. The magnesium powder burned with a flash and started the thermit, which seemed thoroughly ignited almost instantly. In less time than it takes to tell of it the fierce heat developed by the reaction had burned out the thermit paste which had been daubed into the wire-cloth, the wire itself was melted and the liquid steel and the white-hot slag which resulted from the thermit reaction fell into the red-hot mold around the end of the broken tap.

The wire-cloth stage upon which the thermit was ignited is better than all the automatic crucibles of the self-pouring type which can be made. It is only a question of getting the floor of the stage to the right thickness which will just withstand the reaction and which will melt through by the time the thermit steel is ready for the mold. In the experiment described the stage was made just thick enough to hold until the reaction was fully performed. Just as the writer was about to touch the wire-cloth with a sharpened steel wire, intending to tap a hole for the flow of the thermit steel, the wire cloth melted and the thermit steel flowed automatically into the mold. As soon as the steel had cooled to a dull red the mold was broken away and the tap was found to be perfectly welded to a new steel head, which was quickly ground to shape and squared up on an emery wheel. It could be filed readily, but emery wheels cost less and were more in evidence than files. Very thick blue glasses should be worn when experimenting with thermit. Automobile goggles with very dark blue-glass fittings are the best protectors for the eyes. Since making the above experiment, the writer has been trying to weld broken wires in starting rheostats and finds that the task is easily performed. Broken links in a chain have been repaired without removing the chain from its place.

Although thermit may be made at will by the mixture of aluminum and iron oxide, it must be remembered that thermit is covered by patents and any commercial manufacture of the substance makes the manufacturer liable to patent infringement. Hence, while it may be all right to experiment in the direction indicated, the laws of the country must be respected.

Boston, Mass. John Jackson.

CONCRETE FOUNDATIONS FOR ENGINES AND GENERATORS.

In making concrete for machine foundations, it has become almost a traditional rule to use mixtures of cement, sand and broken stone in the proportion of 1-2-3; 1-3-5; 1-2-4; or some other formula, according to the custom of the locality or the ideas of the constructor. In some cases, either of the proportions given may form a concrete, which will be all that is required in the way of strength and density. But, on the other hand, unless nature has given a sand which happens to be exactly of the right composition for the formula used, then the concrete will be anything but strong or solid.

It has been found that while there can be great variation in the quantity and fineness or coarseness of the ingredients used in making cement, and while strong and impervious concrete can be made of almost any ordinary material, it is necessary that the sand and rock shall be combined in a manner which shall cause the total of the combination to approach a certain geometrical curve. That is, if laid out to scale, the size of the particles representing abscissa and the percentage of each grade or size representing the ordinates, the sums of the ordinates shall in all cases approximate some predetermined curve.

For instance, were the old formula of 1-2-3 to be used, the cement representing 1 part in 6 would equal 16 2/3 per cent. The sand, 2 parts, would equal 33 1/3 per cent, while the broken stone equals (3 parts) 50 per cent. If laid off as a curve, this particular cement composition would be represented by the very irregular curve, *o, a, b, c,* Fig. 1. The cement, passing 75 per cent through a No. 200 mesh, will contain a few particles of No.

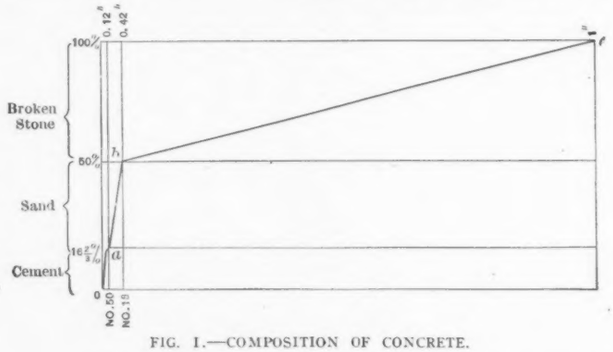


FIG. 1.—COMPOSITION OF CONCRETE.

50, and the curve of a certain cement, plotted to the 16 per cent line, would appear about as the curve *o a.* The diameter of the No. 50 mesh particles is about 0.012 in. Were No. 16 sand to be used, the particles would be about 0.042 in. in diameter, and this ordinate would cut the 50 per cent line at *b,* therefore the sand would occupy the space *a b,* while the broken stone filled the remaining 50 per cent from *b* to *c.* Thus this particular concrete fits the rather irregular curve *o, a, b, c,* as stated. It is a very rough curve, to be sure, and not correct for the formation of the best concrete, but it will answer the purpose of illustration, and of making the concrete mixer do a little thinking—or the man who is to pay for the concrete will see that he is getting

what he is paying for instead of a lot of material which might be proportioned into first-class concrete instead of being dumped together haphazard, perhaps weak, perhaps strong, as the natural composition of the material happens to be.

As there is just one curve which yields the strongest concrete, it will be interesting to see what happens when other mixtures are used in place of the 1-2-3 proportion. Take the next conventional formula, which is often used for building foundations, while the 1-2-3 is reserved for machinery foundations. When 1-3-5 is used for concrete, the percentages become approximately, cement 11 per cent, sand 33 1/3 per cent and broken stone 55 2/3 per cent. Plotting this curve in Fig. 2, there is obtained *o, d, e, c,* which is the curve for 1-3-5 concrete. For the purpose of comparison, the curve from Fig. 1 is reproduced in dotted lines upon Fig. 2, and it will be readily seen that the composition of the two concretes is radically different; therefore, if the one curve is correct, the other is wrong and could be changed to advantage.

By inspection, it will be seen that about the only change made in the two concretes is the substitution of one part of broken stone for one of cement. By actual test, upon blocks made at the same time and from the same material, it has been found that blocks made 1-2-3, crushed at 1850 lb. to the sq. in., at two weeks old, the 28-day test having not been made at this writing. One-inch stone not being at hand when these test blocks were made, gravel screened through a ½-in. sieve, and caught on a ¼-in. mesh, was used instead of broken stone. The chief difference is that less strength was obtained from the gravel than would have been secured from broken stone.

The 1-3-5 concrete, at 14 days, made from similar material and at the same time, failed under 800 lb. to the square inch of pressure. A number of other mixtures were made at the same time, and the results at the age of 14 days were as given below:

TESTS OF CONCRETE MIXTURES.

Kind of mixture.	Seven-day test.		Fourteen-day test.	
	First crack.	Crushed.	First crack.	Crushed.
1-2-3	1,200	1,600	1,100	1,850
1-2-4	900	1,050	900	1,300
1-2-4-5	900	1,050	1,200	1,300
1-3-5	400	450	700	800
1-3-6	300	350	400	500
1-4-8	250	300	500	500
1-1-5	1,200	1,950	2,400	2,550
1-1-4	2,000	2,200	2,400	2,650

From the above table it will be seen that with 16 per cent of cement and 1-2-3 proportion, there is not nearly the strength as where the same percentage of cement is used with more gravel and less sand, or 1-1-4. The same is true with the 14.3 per

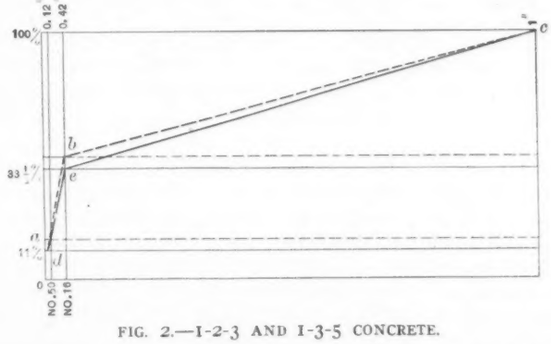


FIG. 2.—1-2-3 AND 1-3-5 CONCRETE.

cent cement mixtures, the 1-2-4 crushing at 1300 lb. while the 1-1-5 crushes at 2550 lb., and is almost as good as the 1-1-4 mixture, though a slightly different result may be found when the concrete has attained full strength. It is likely that the 28-day test would approximate an increase of about 15 per cent in strength over the 14-day figures for all the different kinds tabulated above, but it is doubtful if the 1-1-5 concrete increases much in strength over that shown by the 14-day test.

The 1-1-4 concrete seems to be the one to use when a very strong set is required, and if the curve of this concrete be plotted, it will appear something as shown by Fig 3, line *o, a, h, g;* the point *g,* being drawn back from *c,* on account of ½-in. gravel (0.442 in. diameter) being substituted for 1-in. broken stone, the line *f, g* taking the place of dotted line *f, c,* which was the curve of the concrete as laid down in Fig. 1. It may perhaps be stated here that were 2-in. stone substituted for 1-in., the line would fall to the position occupied by the broken line *f, j.*

When gravel is used, separated between ½ in. and ¼ in. sieves, it is evident that some of the pebbles—in fact all of them—are between the diameters of 0.221 in. and 0.442 in., and it is reasonable to assume that, instead of all ranging in a straight line from *h* to *g,* there are enough of the intermediate sized pebbles to raise the line to somewhere near *i, g.*

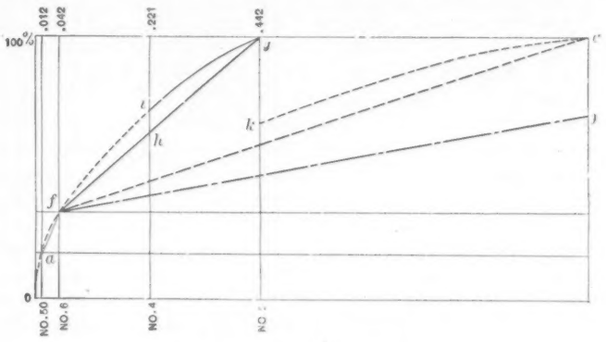


FIG. 3.—1-1-4 CONCRETE OF ONE-HALF GRAVEL.

It is also safe to assume that if the gravel, instead of being cut off at *h,* or at *i,* by the ¼ in. sieve, be cut off by the No. 16 sand at *f;* the dotted curve between *f* and *i,* would be filled out by the intermediate sizes of sand-grains so that a full curve *f, i, g* would result. The same thing is true with the No. 16 sand, between *a* and *f,* thereby forming a fairly uniform curve (including the cement curve) from *o* to *g.*

Investigations have revealed the fact that the curve of the best concrete approximates a parabola, and when points are taken along such a curve, and the percentages of sand and stone or gravel are made to conform thereto, the result will be good concrete, no matter what materials are used as long as they can be made to fill the 100 per cent and to lie all in the curve *o, a, f, i, g.* When 1-in. stone is used the line of that size extends from *f* to *o,* and the intermediate sizes of particles lie somewhere in the curve *k, c.* In a similar manner, when 2-in. broken stone is the largest size used, the curve lies somewhere just above the line *f, j.*

The curves in Fig. 4 are not drawn to scale, and they do not represent the actual curves of the best concrete. They are mere diagrammatical representations of approximately what should be done when concrete is to be proportioned from material of ½-in., 1-in. and 2-in. broken stone or gravel.

Thus, if the largest material available be ½-in. broken stone or gravel, the proportions for the concrete must be taken from the curve which terminates at *g,* that point representing the diameter of the largest particle which can pass through a ½-in. sieve. The cement is supposed to fill from *o* to *a,* about 16 per cent, or thereabouts. If more than this cement be used, its curve will extend too far toward the top of the diagram, and the concrete will not be of the best proportion possible. The result of too much cement will be an increase of strength, but there will be too much absorption, as many neat cement blocks can and do absorb 38 per cent to 40 per cent of their weight of water. Thus the percentage of cement must be kept down, and it decreases as the size of the stone increases.

For proportioning a concrete with ½-in. stone or gravel there may be taken points in the curve according to the sand available. If there be a quantity of No. 12 sand and no other, the quantity of that sand to be used will be the percentage from *a* vertically to *d,* while the stone percentage is from *d* to *g.* If some No. 20 (mortar sand) is available, and no other, a smaller quantity of sand should be used, the percentage being from *a* to *b,* while the quantity of stone must be from *b* to *g,* an increase in per cent from *b* to *d.* While the resulting concrete

may or may not be as strong as some other combinations, it will be the strongest possible from the material that must be used.

It goes without saying that the quality of the concrete will be improved by using both No. 12 and No. 20 sands with the large material. In case both these grades are available, make the cement equal to *o*, *a*, as before, then use No. 20 sand = *a*, *b* per cent; No. 12 sand, *b*, *d* per cent, and stone, *d*, *g* per cent. When natural sand or gravel is at hand, to make the strongest possible concrete, the sand should be screened into its component sizes, No. 2, No. 4, No. 8, No. 12, etc., and recombined in the percentages indicated by the vertical distances between the letters *a*, *b*, *c*, *d*, etc. For instance: No. 20 (and finer), *a*, *b* per cent; No. 16, *b*, *c* per cent; No. 12, *c*, *d* per cent; No. 8, *d*, *e* per cent; No. 4, *e*, *f* per cent; No. 2, *f*, *g* per cent; and cement = *o*, *a* per cent.

This will make the best concrete possible with the material at hand, and, as stated, any of the grades may be omitted at will and good results obtained by keeping the points always upon the curve. The result of omitting one or more grades may be a slight loss of strength and possible increase in absorption, but such loss will be trifling compared to the loss when concrete is made to the "1-2-3" or "1-3-5" rules.

When larger broken stone is available, keep to the curve terminating on the point indicating the diameter of each size of aggregate. It will be observed that the larger the broken stone the less fine sand and the less cement are necessary to keep the proportions in the proper curve. Thus, there is a considerable saving in using the largest size of broken stone possible. This is readily proved by considering the curve as extended indefinitely to the right, making possible the use of infinitely large pieces of stone. This means that the concrete would be one solid rock, consequently there would needs be no cement or sand. Thus the curve demonstrates its truthfulness.

When using the larger sizes of aggregates, work to the points where the curves cut the sieve or screen lines. Thus, for 1-in. aggregate the quantity of each grade used must be kept in the curves *i*, *j*, *k*, *l*, *m*, *n*, *x*. When 2-in. aggregate can be obtained, keep the percentages of each grade in the curves *o*, *p*, *q*, *r*, *s*, *t*, *u*, *v*, *w*, to the point where the curve terminates. Thus, in mixing the best possible concrete with 2-in. broken stone there should be *w*, *x* per cent of 1-in. broken stone, *o*, *p* per cent of cement and a filling-in between of percentages of different sizes as may be available, always bearing in mind that the more grades (within limits) the better will be the resulting concrete.

It is then up to the engineers to lay aside the time-honored 1-2-3 and 1-3-5 formulas, and proportion concrete foundation material in such a manner that the best possible concrete, as regards density, strength and absorption, may be obtained from the material available. This often results in a considerable saving of cement, as well as increase in strength of the concrete.

Willoughby, Ohio. James F. Hobart.

THE CARE AND MAINTENANCE OF ELECTRIC MOTORS.

In starting a motor, first see that the bearings contain sufficient oil and that the brushes bear evenly on the commutator. If a circuit-breaker is used close it, then close the main switch. Rotate the handle of the starting rheostat slowly as far as it will go and hold it in this position until the magnet becomes sufficiently strong to hold the lever. Care should be taken in starting the motor that the handle of the rheostat is not rotated too fast. Standard starting boxes for motors are generally designed to start the motor in not less than 15 seconds with approximately 50 per cent over full-load current. For motors above 20 hp and up to 50 hp, 30 seconds should be allowed for starting with 50 per cent over full-load current, and for motors above 50 hp and up to 100 hp, 45 seconds should be allowed. Where it is possible to do so, the motor should be started even more slowly, as by doing so the current drawn from the line will be kept down to full-load current or below. If sparking occurs move the brushes slowly backward until it ceases, giving the maximum back lead for sparkless commutation at no load, then secure the brush yoke firmly in position. The brushes having once been adjusted to the proper running position should not be moved when starting or stopping. See that the oil rings are revolving freely and occasionally feel the joints and contacts; if any part is unduly warm, a defect is indicated and should be immediately remedied.

To stop a motor, open the circuit-breaker or switch which will cut out the resistance of the starting box. Never attempt to stop a motor by forcibly pulling open the starting box. Disregard of these instructions may cause burning of the field coils. The commutator is an important part of every direct-current

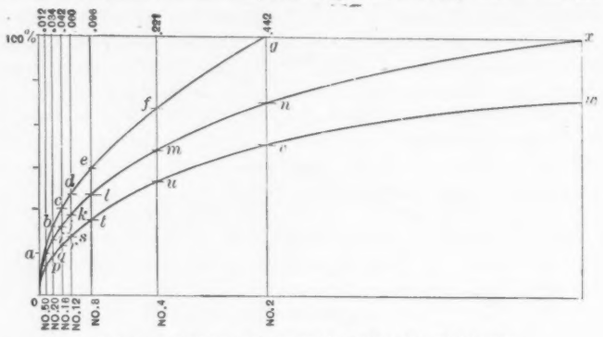


FIG. 4.—CURVE FOR PREPARATION OF CONCRETE.

motor and requires careful and intelligent attention. Whenever possible the care of the commutator and brushes should be assigned to a competent man who is held responsible for their proper attention. The first essential to satisfactory commutation is to keep the commutator clean. Ordinarily this will require only a daily wiping with a piece of canvas. In service the ideal appearance of the commutator is a polished surface of dark brown or chocolate color. Sand paper, carborundum cloth or sandstone should never be used on a commutator that is taking on a polish and shows no signs of roughness. Commutators which do not polish properly and show signs of roughness should first be smoothed off with a piece of sandpaper. If quite rough, a piece of sandstone may be used to advantage. Flat spots sometimes occur on commutators. They are usually caused by excessive wear, by too much end play, by bad belt splices or by flashes produced by short-circuits on the line. When the commutator becomes out of true it should be turned. A small amount of lubricant may be applied to the commutator, such as a piece of paraffin, which, if rubbed across the face once a day, will be found sufficient in the majority of cases. Lubricants should always be used sparingly and never in sufficient quantities to accumulate on the surface or about the brushes.

The successful location and remedying of motor troubles requires much thought and good common sense. There is never a trouble without a cause and trouble can be found if persistently looked for with the aid of a few simple appliances.

The main trouble with direct-current motors is sparking, which may be caused by any of the following defects: The brushes may not be set on the point of commutation; if so, a point can always be found where there is no appreciable sparking and the brushes should be set and secured at this point. The brushes may be wedged in the holders; if so, remove one at a time and grind off the side that binds. The brushes may not be fitted to the surface of the commutator; they may not bear on the commutator with sufficient pressure; they may be burnt, which usually indicates that the shunt connecting the brush to the holder is loose. The commutator may be rough; the motor may be overloaded; the mica may be pitted between adjacent commutator bars. These are the most common causes, but sparking may be due to an open circuit or loose connection in the armature. Such troubles are indicated by a bright spark which appears to pass completely around the commutator and may be recognized by the scarring of the commutator at the point of open circuit. The existence of a short-circuit is indicated by excessive heating in the affected coil.

Brooklyn, N. Y. C. J. Thomas.

QUESTIONS AND ANSWERS

What is the usual ratio of generator and line voltage in transmission systems? H. P.

There is no definite ratio used. Usually it is best to have the generator voltage one-quarter to one-sixth the line voltage.

What effect would a drop in speed on an alternator have on three-phase motors connected to it? H. W.

The output of induction motors varies as the square of the voltage, so that if the decrease in speed is sufficient to affect the voltage of the system, the output of motors attached to the system would be diminished.

How is an ammeter calibrated from a standard instrument of the same type? P. G.

The two instruments should be connected in series; the current is measured on the standard instrument, and the deflections are compared. A storage battery is usually used in connection with this work, since the current can be maintained constant. By changing the current strength various readings are obtained.

What is meant by the term "windage" referring to losses in dynamos, etc.? L. H. R.

The term "windage," as applied to the losses in dynamos, refers to that loss occasioned by the movement of the armature through the surrounding air. Its effects are similar to those due to friction and the total loss is usually referred to as the windage and friction.

What is the greatest height to which chimneys have been built? K. H.

The tallest chimney in the world is said to be at Great Falls, Mont. This is 506 ft. above the top of the foundation and has an internal diameter at the top of 50 ft. The chimney is proportioned for leading off 4,000,000 cu. ft. of gases a minute with a maximum temperature of 600 deg. Fahr. The gases consist mainly of sulphurous acid from smelter furnaces. The total dead weight of the chimney is estimated at 17,000 tons.

We have two instruments in which the pointers do not come to zero. The scale on both instruments is unevenly divided and we would like to know how to correct the readings. A. G. W.

When the pointer of an indicating instrument with an unevenly divided scale does not stand at zero with the instrument on open circuit, the only proper method for making corrections is to determine the actual distance between the zero on the scale and the position of the pointer when the instrument is out of service. Then add or substract this distance mechanically along the scale at each indicated reading of the instrument.

It is desirable to operate a number of frequency changers in parallel. The motors are of the 30-cycle, self-starting, synchronous type and will be operated in parallel without synchronizing connections. How can these machines be made to share the load? Can the field excitation of the 60-cycle generator ends of the frequency changers be varied to bring about the desired result? N. E.

The division of load between alternating-current generators driven by synchronous motors cannot be brought about by any of the usual methods. Varying the field excitation will not alter the distribution of load, but will cause wattless currents to flow between the machines. The proportion of load carried by the various sets depends entirely upon the angular position of the rotors and stators of the motors and generators with reference to each other. The angular position of the low-frequency rotors must have exactly the same relation to the high-frequency rotors in all the machines. Otherwise the sets if operated in parallel will not share the load.

What is an induction regulator and what are its uses? C. C.

The induction regulator is a special type of transformer built somewhat like an induction motor with a coil-wound secondary, which is used for varying the voltage delivered to a synchronous converter or alternating-current feeder system. Inasmuch as it is operated without opening the circuit and without short-circuiting any transformer coil it possesses an advantage over the variable ratio transformer. On the other hand it has a large magnetic leakage and requires a high value of exciting current. The primary of the induction regulator is subjected to the constant voltage of the supply system and the delivered voltage is varied by combining with the supply voltage the e.m.f. generated inductively in the secondary. The secondary is normally stationary, although it is movable at will for the purpose of varying the voltage. The single-phase induction regulator is used on lighting circuits and the polyphase induction regulator is used chiefly in connection with rotary converters and similar apparatus.

Some time ago we rewound a 16-kw, 220-volt, bipolar armature from a dynamo and when the armature was replaced and brought up to speed it would not generate. The machine was driven by a gas engine. After trying all kinds of connections we could get no current. We decided to charge the field coils from an outside source of supply and after we had done so the machine built up fine. We then saw that the trouble was due to the lack of residual magnetism. Is there any instrument which will tell whether there is any residual magnetism in a field pole or not? If so, of what does it consist? C. F. K.

It is probable that a generator which refused to excite itself when a rewound armature was substituted for an old armature, but subsequently was excited properly from an external source, would have excited itself properly if the field circuit terminals had been interchanged one with the other; that is to say, it is very likely that the machine initially possessed residual magnetism, but the electromotive force generated by the armature had such a direction that the current produced by it in the field coils tended to demagnetize the field rather than to increase the field magnetism. Residual magnetism may be frequently detected by means of a small pocket compass.

Kindly define and explain what is meant by the term "power-factor." R. E. O.

The power delivered to an electric circuit is at any instant equal to the product of the current strength in amperes and the potential difference in volts, and this power is expressed in watts. With direct current the e.m.f. and current strength remain constant for a finite time and are indicated on instruments suitably connected in circuit. The watts are also constant. With alternating-currents the e.m.f. and current strength are constantly changing in accordance with some periodic law. It is still true that the power is at any instant equal to the product of the volts and amperes at that instant. But alternating-current instruments indicate the square root of the average squares of these instantaneous values or what are called the effective values, and not the instantaneous values. The product of the effective volts and amperes is generally greater than the average of the products of the instantaneous volts and amperes. The factor by which this product of effective volts and amperes must be multiplied in order to obtain the true average watts is called the power-factor.

Is it possible to operate a small water power plant during the day without the presence of an attendant? T. A. C.

There are many small water-power plants in operation where the number of attendants is reduced to one. We have seen a 600-kw water-power station, however, in upper New York without an attendant. The station feeds a railway system and is kept locked during the day, a man visiting it occasionally to look after the oil wells and brushes. The equipment is interesting in that uniform voltage is maintained without a governor or any other regulating device. The station contains six 150-hp vertical-shaft waterwheels direct connected to six 100-kw generators. Each generator is provided with a strong series field and comparatively weak shunt field. When the waterwheels are running at full speed with gates wide open and with no load, the generator working on shunt field alone has a voltage of 550. As the load increases and the speed drops, the current in the shunt coils drops also, but the current in the series coils increases and the winding of the series coil is so proportioned that the total flux increases with decrease in speed, or in other words the flux increases with the load. In this way the decrease in speed of the armature is compensated for by an increase in the strength of the series field and a practically constant voltage is assured. The station has operated continuously for a number of years with practically no attention.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Public Policies in Public Service.

By H. H. MacPherson.

THE financial storm that swept over the country last fall has blown the dusts of concealment from many secret corners of the big corporations and has shown the necessity for plans and policies toward the public that, under ordinary circumstances, would not have become necessary for several years. In the case of the public service corporations, a study of these plans and policies has a vital bearing upon the success or failure of some 5000 central stations in safeguarding their investment from the perils of drastic public control.

No one denies that we are face to face with a good live "Public Service Problem." The papers and discussions on public policy at the N. E. L. A. convention on the one hand, and the growth of regulation of public utilities by commission on the other, show only too plainly that this time it is no passing fancy.

The present unreasoning fanaticism of the public on this question when met by the usual complacent superiority of the average central-station manager will eventually lead to unwise legislation extremely damaging to the interests of both. There is too much recent first-hand evidence of the truth of such a statement to make it necessary for anyone to accept it as such without adequate proof.

The case of the Minneapolis General Electric Company is an excellent example of an absolute failure on the part of the company to realize the real condition of the public temper in this regard. This company had spent several years of close study on the question of rates, and arrived at the conclusion that the maximum demand system was equitable and just and decided to introduce it in Minneapolis. So, without considering the past record or the public opinion on the matter and trying to educate them up to it, the company calmly introduced its new schedule of rates to the City Council. The resulting storm of bitterness toward the company took it off its feet, so that it actually tried to calm this aroused public sentiment by a series of statements. These statements were absolutely true and admirably written, but they were of no use because they were too late. The public's outraged sense of justice kept it from using either reason or common sense in the steps which it took. The result was that after a wrangle lasting a year a truce was patched up. Each side has won a partial victory, but thereal issues remain substantially as they were before. The people fought against a method of making rates which involved so many variable factors that, in the words of one of the Minneapolis papers, "It is a device to promote unjust discrimination, a scheme solely for the purpose of permitting the company to charge any sum it pleases."

The above method of making rates was finally upheld because it was proved to be just and equitable and based upon the cost to the company of supplying the consumer. The company regards this as conclusive evidence of the justice of its own position, and of the unreasonableness and lack of knowledge of the public in such matters, and thus no lasting good has been done. The rate discriminations of which the public complained so bitterly are more securely hidden under the new system than under the old, and the company is secure in this system because it has been proved just and equitable.

Such cases as the above add force to the words of one of the most progressive of managers, when he says: "In the last three years corporations have come to realize that the public can no longer be damned, and it is being found out every day that this world would be much happier if some of the harder-headed captains of industry had found it out sooner."

To the average citizen the spectacle of a gas and electric company fighting strenuously to prevent a reduction in rates on the plea of confiscation, going serenely on its way after the reduction has been ordered, must be enlightening as well as entertaining.

Such facts in the face of public statements to the contrary has inextricably put into the public mind a reasonable doubt as to the sincerity of the higher officers of all public service corporations, and explain the unjust attitude which characterizes the public view of every fair position which the companies take up. The companies have tried to get away from their past by means of statements setting forth the justness of their present positions, with the result that no progress was made because of the charge of insincerity.

New business and complaint departments conducted along proper lines have done a great deal, but one of the most virulent fights of the age was against one of the most progressive companies along these lines that there is in this country. Our Massachusetts friends have held up the results of the Boston Edison Company as an example of what can be done by a proper understanding of real conditions and fair treatment of the public. However, very recently the Public Franchise League has made that company fight to hold all it had gained.

The failure of the managements of corporations to appreciate the conditions confronting them left it to the public to take the first adequate steps looking to a solution of the problems of adjusting the differences between the companies and the public upon an equitable basis by the appointment of public service commissions. The true wisdom of attacking the problem in this sort of an arbitrative way is now coming home to these managers, as was plainly shown by some remarks made during a discussion of a paper by Mr. Henry Floy, presented at a recent meeting of the American Institute of Electrical Engineers.

Central station managers have in reality brought the regulative control by State commissions upon themselves, because they have for years corrupted and controlled local councils. In just so far as they keep themselves from attempting to influence or control these commissions, but instead forestall their actions by weeding out the unjust and discriminative practices which are sure to be first attacked, they will make this control by commission broad and beneficial to all concerned.

Mr. H. M. Brinkerhoff, of New York, strikes a keynote in this matter, and shows how the companies should encourage every thoughtful, open-minded citizen to study this question from an economic standpoint. He says: "It is probably impracticable at the present time to expect matters of this kind to be talked on around the table in a fair, candid discussion, but if such a course could be pursued I am satisfied much better results would be obtained than by the formal legal methods now in use. Our commissions would very seldom go radically wrong if they had the real facts placed clearly before them. Two conflicting, cleverly concocted partisan statements, on the contrary, befog rather than clear the issue. We operating men and engineers are too apt to feel we are in a class by ourselves which separates us from general citizenship. That is the weak point in our national life to-day. Large classes of educated, highly trained brain workers in our land leave great public questions, great economic questions, which really vitally affect themselves, to a few professional politicians and reformers."

In the quotations and discussions given below the evidence of some of the best minds in the country, wherever found, will be used in an attempt to prove that the public service corporations themselves should study these questions from an economic as well as from an engineering standpoint and co-operate with their respective councils, boards or commissions in stopping all practices which by arousing public resentment tend to obscure the real facts involved.

The public service problem can be summed up in the words, Public Selfishness vs. Corporation Greed. The public believes that public service corporation graft is the cause of all our rotten municipal politics. The public service corporations say that the unreasonable attitude of the public toward them is the cause which has driven them to the necessity of controlling municipal politics in order to save their investment.

However unreasonable the public attitude may be, it is absolutely certain that it has not taken up that attitude without some reason, and that it is not going to change that attitude until those reasons are removed. Then it is certainly the duty of the public service corporations to find those reasons and remove them, for if they do not do so they will be the first victims of the wave of sentiment in favor of drastic public control of corporations.

Managers have a way of saying, "Well, what of it? You can't change the course of the whole world in five minutes." That is true. But the nearest thing to it is the way in which an aroused public can rope up and tie hand and foot the public service corporation that fails to keep its ear to the ground.

The municipal ownership bogey of 10 years ago is changing to the much more dangerous form of regulative control by public service commissions. The long procession of municipal ownership failures, particularly in the lighting business, had begun to have its effect in a loss of public confidence in the wisdom of municipal ownership or operation. The proved financial failure of that principle when subjected to practical tests was the strongest argument against it. However, the control by commission is just the thing for which the public has been looking. The other fellow takes all the risk and the commission bosses the job. That always has been and always will be an easy proposition—for the boss.

A recent editorial in the ELECTRICAL WORLD says: "One of the features of importance which has characterized the central station during the past year is the establishment of the principle of State regulation of electric lighting corporations as a public policy which promises soon to become fixed as a statute in all the States." In a later issue of this same journal appears this complete summing up of the situation: "It is now squarely up to the companies to increase public confidence in their work to the point that shall make private ownership and operation under the broad regulative control of public commissions universally preferable to municipal administration and ownership." It rests with the companies so to conduct their business that this control shall be broad and not narrow.

It is the object of this paper to set out fundamental causes and effects bearing upon this problem, to the end that the control shall be kept broad by reason of a thorough realization on the part of all companies of the conditions which they are forced to meet. Up to the present time these conditions have been fully realized only when they were forced upon the companies by the people.

The most progressive managements of to-day give good service at reasonable rates, and through new business, publicity and complaint departments apparently take care of every phase of the public end of the business. However, the three most recent and most virulent franchise fights that this country has seen were in cities where the company was under the most progressive kind of management. It may be said that those fights were the result of public prejudice engendered by previous managements, and that is undoubtedly true in a degree; but the analysis will show that the prejudice was fed at just the wrong time by the companies themselves through their failure to realize some of the most important conditions imposed upon those engaged in public service.

A Minneapolis writer who sees clearly that the company was right in the main but that there is a great lesson yet to be learned by central station managers writes as follows: "Among central station men the country over, the justice and economic soundness of the modern system of selling electrical energy on the maximum demand principle, is fully appreciated, but the recent events in Minneapolis in connection with the proposed new franchise, for which the Minneapolis General Electric Company is now negotiating with the City Council, illustrate very forcibly the woeful ignorance of the general public in all matters connected with rate making in the central station business, and particularly their utter lack of knowledge of the fairness of the maximum demand system. The recent Minneapolis experience also shows how costly ignorance may become to the central station company by forcing it to accept an unfair and uneconomical system of rates; it also points out the wisdom of carrying out, before it is too late, a comprehensive policy of public education in the principles of rate making."

Although much progress has been made along this line as a result of recent bitter and very costly fights in certain cities, the real truth regarding the facts as found has been distorted by both the companies and the public because of the prejudice on both sides which always rules at such times. The conclusion of the Minneapolis fight shows this quite clearly. The company thinks its victory is complete because the maximum demand system of rates was upheld and that was what it was fighting for. The people think they have won because they have reduced the rates to the small consumer to a more equitable basis. The trouble is that neither party now sees the rights of the other in any light other than a suspicious one. Both are anxious to see that the other one does not make any more moves.

Before a company can educate the public it must know what it is talking about. Those companies which have been through the mill most recently certainly know whereof they speak. The companies themselves as well as the inquiring bodies have shown a commendable desire to get at the real truth. But at the start the differences at issue were so great, and the actual ignorance of each of the real position of the other was so appalling, that much real injustice was done to the companies.

The cases cited below bring out plainly so many vital facts regarding the real conditions and show well that both sides are wrong and that there is a strictly practical middle ground which will eventually become the basis of a successful solution of this "problem." Each case is a lesson in itself. And a good plain lesson properly studied should help every company in the country to educate its public in the right way.

In the case of the Public Franchise League vs. the Boston Edison Company, Mr. Burdett, for the company, put into words the up-to-date attitude of his company as follows: "The commendable purpose of the organization which registers this complaint is alleged to be to help to bring about fair and friendly relations between the public service corporations and the people. The confidence and approval of the thinking men of the community is the breath of life to such corporations. The time for the display of corporate arrogance toward the public has long ceased to be. The company must in its own interest seek to retain the confidence of the public which it serves. In doing so it must not permit itself to be swayed by popular clamor into the abandonment of sound business principles. It cannot seek popularity if thereby it invites ultimate disaster. For the mere sake of seeming to go right it must not in fact go wrong. It has a right to rely upon its superior knowledge of the principles and practice of the industry in which it is engaged." And in conclusion he says: "The company seeks the affirmative indorsement and commendation from the commission and public which it believes it merits."

The end of the war of extermination in Baltimore, Md., was reached by a merger of all the electric central station interests under the control of the Consolidated Gas, Electric Light & Power Company. The new management showed its appreciation of the legitimate interest of the public by issuing a complete statement of its position, a resumé of which is given below.

"It must be undertood that the securities on which interest and dividends are thus provided for represent actual cash invested. It has been known by all familiar with such matters that electric energy has been sold in this city at a price below the cost at which it could be produced. It could therefore only be a question of time when these companies must either have agreed on a uniform rate or one company pass under the

management of the other. I believe that in supplying abundant electric energy for industrial purposes the development of the manufacturing interests of this city will receive an impetus impossible to be obtained from any other source. All this requires large outlays of money. This money is secured by the sale of the securities of these companies. You cannot sell the securities of a company to advantage when that company is forced to sell its product made by the use of the money received from the sale of its securities at a price less than it cost to produce that product. Therefore when a community secures electric energy at less than its cost of manufacture the effect of compelling such a destructive policy is to stop the investment of money in providing the essentials for the manufacturing or business growth of a city.

In the general plans outlined there are no promotion stocks, no increase or exchanges of securities. Only the machinery necessary to properly conduct a business of the magnitude as that contemplated has been provided. Under the proposed plans a broad and comprehensive system for supplying this city and suburbs with electric energy for lamps and motors can be completed, and the immense outlay of money necessary to its success can be obtained when purchasers of bonds for extensions and improvements can be assured of safe investment for money paid to the companies.

"In this connection I might state that the management of these companies has full regard for the rights of the public and the duties of these companies to the city and to the people. Unreasonable rates shall not be charged, and I am authorized to state as a result of the plans developed and developing and briefly outlined, the people of Baltimore shall be able to purchase electric energy at a price lower than that charged in any of the large cities in this country. It will be the policy of the Consolidated company to maintain prices below those of the other cities."

In the case of the Wisconsin State Railway Commission vs. the Lacrosse Gas & Electric Company the decision of the commission says in part:

"The petitioner (the company) has duties as well as rights in this matter. While it is entitled to reasonable rates for services it renders it has not the right to exact more than this. It must also see to it that the services it renders are adequate and that they meet all reasonable requirements in this respect. It is as important that the interests of the public it serves should be as fully protected as those of its own. The best rates are those that are based upon the cost. Each consumer should under ordinary conditions contribute his just proportion of all the expenses as well as of the interest upon the investment."

In the case of the Saratoga Gas, Electric Light & Power Company vs. the Gas and Electric Commission of the State of New York, the company took the point of view that such commissions are unconstitutional and therefore its orders are void and of no effect. In respect to the particular order in question the company may have taken a correct position, but its conclusion in the premises was as absurd as the position taken in the Attorney-General's answer was sensible. The company concluded its argument in part as follows: "The act is an unprecedented experiment in state socialism and the next logical step is the open assumption by the state of paternal power over all the attributes of private property invested in these industries, namely, the legal taking of such property without compensation. This court therefore should deliberate long and earnestly before upholding the novel principle represented in the gas commission law, which, however popular for the time being, is in reality part of a bureaucratic and not of a democratic system of government, and may lead to infinite mischief in the future." The reply of the Attorney-General was in part: "No precedent for annulling such public action should be established on a record like this which fails to raise a reasonable suspicion that the rates quoted in this case are unfair to the appellant. The special attention of this court is invited to the importance of this case as the precursor of attacks on the validity of the public service commissions law, undoubtedly to follow."

A study of these quotations will show conclusively that both the public and the companies have been unreasonable; that frank discussion between the company and the commission will eventually result in a mutually satisfactory understanding; that public service control by commissions has come to stay; and that it will be a bad or a good influence, whichever the companies honestly wish to make it.

By expert testimony in such cases as those just cited the public has been educated to the fact that it knows very little about the technical end of the business and the science of rate making; and the companies have learned that the public has a right to know how and upon what general plan the company conducts its business.

It every case the public has shown a general feeling that too high rates are being charged for the service rendered, and that any system of rates based upon anything but a straight rate per kw-hour breeds unjust discrimination. The most bitter part of all these struggles has been over the system to be used in estimating rates, because the public has always stood solidly for a system of rates which would be so simple and clear that there could not possibly be discrimination in rates. In striving to attain this object rates have been proposed which bore no relation whatever to the cost of supply, and in the case of Lacrosse at least, they were even lower than that cost.

The net result has been of great benefit in determining absolutely what is a proper method of charging for gas and electricity. Proper accounting methods, which include maintenance and depreciation so long neglected in the final cost, have in each case established more and more prominent precedents for charging each class of consumers according to what it costs the company to serve them, rather than according to average figures.

As Mr. Burdett says, "The company has a right to rely upon its superior knowledge of the principles and practice of the industry in which it is engaged." Thus central station interests have regarded as a signal victory every decision in their favor regarding the rates charged and the system used in estimating them.

However low these rates may go and no matter how firmly established the system of charging according to the cost of supply may become, the public will make trouble until all unjust discriminations are stopped wherever they exist, whether in rates or in other special favors. That is the real thing for which the public is fighting.

The only company that seems to have realized this vital fact and to have taken steps to satisfy the public that it is honest in this respect, is the Edison Electric Illuminating Company of Brooklyn. In a published statement it says: "The Edison Electric Illuminating Company of Brooklyn believes and acts upon the theory that any permanently satisfactory business must be built upon the basis of mutual advantage, and that this mutual advantage consists in giving the public the best possible service at a price consistent with the maintenance of such service and a reasonable profit to the stockholders upon their investment. The companies securities represent capital actually invested in the business. The companies rates are so arranged that with careful and economical administration and the maintenance of a high and even liberal standard of public service, they permit of the payment of a reasonable return on this investment. These rates differ in accordance with quantitive consumption as governed by minimum guarantees on the part of the customer, and in accordance with certain broad divisions of application, as being for instance lower for energy box motors than for lamps, but there are no secret rates and no discrimination as between customers in the matter of rates, all rates being public and the same rate being charged in every case for similar service under similar conditions. These facts being as stated, this company believes itself entitled to the good will and confidence of the Brooklyn public."

The whole tone of this statement appeals to the public sense of honesty and straightforwardness. If the actions of the company conform to this statement it will be of immense help in bringing the people to an understanding of the policy of the

company. But if the actions of its employees, particularly the higher officers, do not conform to this advertised policy, such publicity is worse than useless.

Insincerity is inextricably associated with the higher officers of a public service corporation in the mind of every citizen. It has been put there by as logical a train of circumstantial evidence as ever convicted a murderer. The very nature of the business of supplying gas and electric service to a city makes it necessary for the company to have the good will and active assistance of the city government. In keeping its established lines in repair, in making extensions, and in the matter of city contracts, the company is absolutely dependent upon the city hall. If the city hall is not willing or is slow in doing its part, it must be made willing, by working upon its own selfish interests. When it took too much to do the work the city hall was cleaned (?) and less expensive men installed. This meant simply working the selfish interests of influential business men to help the company do the cleaning. Then came the time for getting the new franchise and the company had to line up on its side both the political and business interests, no matter how much it cost. History records that in most cities this last has been done at least once. At each successive step the chain of "graft" tightened around the neck of the company because once started it continued to spread. Those who were not on the inside either wanted to be or felt the discrimination in paying their own as well as the grafters' bills. Those who were not on the inside constituted something like 90 per cent of the voters but their vote was "delivered" by the other 10 per cent—for a consideration. In the last analysis the majority rules and when that chance comes the bitterness of years is let loose in unwise and unjust legislation against the cause of it all—unjust discrimination by the public service corporations. That is why such drastic laws are passed when the public does get aroused to action.

In a few instances such as those just cited central station managers are alive to the real conditions and are taking steps to put themselves in the right position by eliminating those practices which arouse such violent public resentment. However, the large majority still regard themselves as abused by the public and they resent any close inquiries regarding the methods of conducting their business. This fact is proved by the tone which has pervaded every discussion on this subject at N. E. L. A. conventions.

The New York, Boston, and Brooklyn Edison companies under the spur of their respective state commissions have blazed out their own methods of co-operation with the commission which bid fair to work out satisfactorily for both sides. They have been forced to do this to prevent the control from becoming too drastic. If they had started this same plan five years ago on their own initiative they would have spared themselves their present troubles. It behooves any company which has not yet received its share of that kind of trouble to learn its lesson by heart and treat the people properly before it is too late.

Advertisements from Rockford on Service Reliability.

The two advertisements which are reproduced herewith from recent issues of Rockford (Ill.) daily papers, show what the Rockford Electric Company is doing to impress on the public the efforts the company is making to give reliable service and the large number of men employed in order to maintain good service. There can be no question as to the good effect of such advertising on the public mind, especially when it is backed up by work that justifies all the claims made.

Have You Ever Noticed

The Efficiency of Our "Trouble" Service?

The next time you have occasion to report trouble with your lighting, just notice what a short time elapses between your telephone call and the appearance of our Trouble Man at your door. Prompt and Efficient Service in every particular is our aim.

ROCKFORD ELECTRIC COMPANY

We have 100 Men, 4 Horses and Wagons, 2 Automobiles, and 4 Bicycles Serving and trying to Serve you.

If your Electric Service is not satisfactory in EVERY particular, write or phone us. We have 17 telephones and are yours to command at any hour ---day or night.

ROCKFORD ELECTRIC COMPANY

CENTRAL STATION ADVERTISEMENTS FROM AN ILLINOIS PAPER.

The Electric Company at Northampton, Mass.

BY WILLIAM H. STUART.

The Northampton Electric Lighting Company, operating in the city of Northampton, Mass., has a very thriving and busy field. The city is the county seat of Hampshire County and has a population of 20,220. It is the center of a truck-farming

district and numbers among its industries silk mills, basket factories and steel-cutlery works.

HISTORY OF PLANT.

The first electric-light station was started by the company on Masonic Street about 1888 with an equipment of 50-hp capacity. This plant was run for about five years. In the year 1892 the station was moved to West Street, along the side of the Mill River. This was a new building with the same equipment, which was operated until June, 1907, when the entire equipment was changed over from single-phase to three-phase.

The old equipment consisted of three Stearns 150-hp and one Holyoke 150-hp boilers. There were two Buckeye engines, 550 hp and 370 hp, respectively, and one Slater 500 hp. The generators consisted of two 180-kw and one 120-kw General Electric single-phase, alternating-current, 1150-volt machines; one 75- and one 50-kw, 500-volt direct-current machines, and two Brush arc machines of 120, 1200-cp enclosed-arc lamp capacity each. All the machines are belted. The switchboard apparatus is made up of four boards, on separate commercial arc-lamp board, one incandescent lighting board, one generator board composed of four panels, two generator and two exciter panels and one alternating-current street-lamp board of four panels.

The new equipment now being operated is composed of the same boilers and engines with the exception of the Slater 500-hp engine which is replaced by an Allis-Chalmers steam turbine driving a Bullock 500-kw, three-phase, alternating-current, 2000-volt machine. The 550-hp Buckeye engine will be changed over from a belt drive to a direct connected one, driving a Bullock 400-kw, three-phase, alternating-current machine. The three General Electric alternating-current machines will be removed and a Bullock 150-kw, three-phase, 2000-volt machine will be used in their stead. The boilers are equipped with four Foster superheaters. The station complement consists of one chief and three engineers, three firemen and one helper.

The lines are all overhead. The transformers are all set on the poles and are used individually. The arc circuits are tested out every day. The meters are kept in a large room at the office of the company. One man looks after the testing, repairing and setting of all the meters.

COMMERCIAL FEATURES.

The offices of the company are located in the center of the town on the main street in somewhat small quarters for the work. They have no sales or showroom. The consumers' ledgers are of the loose-leaf style.

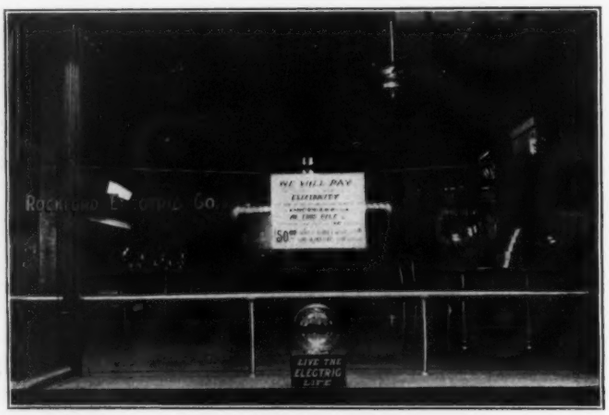
The company has no new-business department, but depends upon what business comes to it and the work of the officials. An effort is made every once in awhile to secure as much business as possible. They have done very little advertising, but expect within a short time to begin quite an extensive series of advertising and active new-business campaigns. The company carries a stock of appliances, which are sold at cost. A number of flatirons have been installed. Those consumers wanting signs have to buy and erect the signs themselves. The company furnishes no lamp renewals.

The rates for current are: Incandescent lighting rate, 20 cents per kw-hour with discount for prompt payment. The power rates are: Base rate, 10 cents per kw-hour with a discount of 10 per cent. There is a sliding scale of discounts which begins at 20 per cent if a bill amounts to $10. As the amount of the bill increases $5 a step the discount increases 2 per cent for each corresponding amount.

The officials of the company are: C. H. Pierce, president; C. E. Gould, secretary and treasurer; C. B. Day, assistant manager; C. H. Hill, chief engineer; Samuel Cook, chief electrician.

A Guessing Contest.

The accompanying reproduction from a photograph of the Rockford (Ill.) Electric Company's show window indicates a scheme that company is working to arouse interest in wiring residences. A pile of pennies is placed under a globe in the center of the window. A sign above this globe reads "We Will Pay One-Half the Cost of Wiring for Electricity the Home of the Person Guessing Nearest to the Correct Number of Pennies in This Pile, Providing Said Half Does Not Exceed $50. The Contest Closes July 20. Come In and Leave Your Guess." A great deal of interest has been shown in this novel competition and its even more novel prize.



SHOW WINDOW AT ROCKFORD, ILL.

The "Great White Way" at St. Joseph, Mo.

Felix Street, the principal retail thoroughfare in St. Joseph, Mo., has been provided with special lighting by means of lamps placed on ornamental posts, and it is now called the "Great White Way" of St. Joseph. A view of the street is shown herewith. The Felix Street Improvement Association pays for the electrical energy used in lighting these lamps, which is supplied by the St. Joseph Railway, Light, Heat & Power Company. The owners of the property pay for erecting the posts and the tenants pay the monthly bills for current. The current is brought to the posts mainly through alleys, overhead work being run to the entrance of the alley and then underground conduit to the nearest post. The cost of installation was $1.50 per front foot, not including the conduits, which were laid by the city.

FELIX STREET, ST. JOSEPH, MO.

The blocks are about 350 ft. long and there are eight posts per block, four on each side of the street. Each post has one 50-cp Gem lamp in the top globe and four 40-cp Gem lamps in the four lower globes. The 50-cp lamp in the top globe burns all night, the average hours burning of all lamps per night being 3.5 hours. The contract for current is at $75 per post per year under a two years' contract.

Increase of Non-Peak Load at Detroit.

Since the beginning of the financial depression last fall which caused the shortening of the number of working hours per week in factories, the Detroit Edison Company has been making considerable progress in the way of introducing its non-peak form of contract whereby the manufacturer using electric power gets a lower rate by virtue of shutting down his motors before the evening winter peak load comes on the station. Under the non-peak contract the customer pays $3 per month per kilowatt of maximum demand instead of $4.50 per month which he pays under the regular contract. This means practically that the factory has to close at 4 p. m. during the winter. When the financial depression came on, the natural course of procedure under the old order of things would have been for the factory to shut down for one or two days a week, keeping the former working hours. With the financial advantage of the non-peak contract before them, however, some of these manufacturers have made it a practice to close the factory earlier each day of the week instead of reducing the number of days' work. In the case of one large Detroit manufacturer the saving by the non-peak contract amounts to $450 per month, which in these times, when cost of production is being closely scrutinized, is something any manufacturer will consider.

INTERIOR WIRING AND ILLUMINATION

Illuminating Engineering.*

BY J. R. CRAVATH.

The contractor who has a sufficient knowledge of illuminating engineering so that he can go to the dissatisfied user of an unsatisfactory lighting installation and guarantee him more results for the money he is expending for light, can create business and get work which otherwise would not be available. The contractor who can build up a reputation as a combined illuminating engineer and contractor, who can go to the owner and say definitely what improvements he can guarantee and how much they will cost him completed, has a valuable asset, and on many jobs he will be independent of ordinary competition. These facts seem so evident that it will not be necessary for us to further discuss them.

The artificial illumination of the majority of rooms is accomplished by a combination of direct and indirect lighting; that is, some light comes directly from the lamps and from the reflectors over the lamps, and some comes from the walls by irregular or diffuse reflection. If we receive all of our light directly from the lamps and reflectors and none from the ceilings and walls by reflection, we must have many sources of light in a room if we are to avoid annoying, sharp shadows. On the other hand, in a room with perfectly white walls, the amount received by reflection from walls and ceilings is so great a percentage of the total that shadows are not nearly so annoying. One of the first things to be considered in planning the illumination in any kind of a room is this question of shadows.

Another consideration that comes into all artificial illumination problems is the placing of the lamps with reference to the eye. The less lamps are exposed to the eyes of persons using the room, the lower the actual illumination required for the reason that the exposed lamps have a certain blinding effect which makes surrounding objects less distinctly visible than if the lamps were shaded. These two fundamental considerations are most important, and yet cannot be taken into account when we consider simply illuminating efficiency aside from the effect on the eye and the avoidance of too sharp shadows.

*Abstract of an address before National Electrical Contractors' Association, Chicago, July 16, 1908.

Speaking of efficiency, what is usually meant by efficiency of illumination? It is a difficult thing to define, because, as a matter of fact, so many elements enter into it. We may measure the total amount of light given out by the lamps in a room and we may measure the total amount received on a plane 30 in. from the floor over that entire room, and we may call the percentage of the total light received on this plane the efficiency of illumination. This does not, however, take into account the fact that the illumination may be delivered in such a way that it is not satisfactory to the occupants. For example, one of the most efficient ways to illuminate this room, if we measure only the light delivered on a plane 30 in. from the floor, would be to hang lamps at frequent intervals on drop cords and equip them with some efficient form of conical mirrored reflector which would throw all of the light down onto the level of the tables and chairs. Such a method could not by any means be called satisfactory, however, for obvious reasons. Leaving out of account the question of the ludicrous appearance of this room equipped with drop cords and opaque shades, you would also find that if it were so illuminated it would be very trying on the eyes. The upper part of the room would be in darkness and the contrast in illumination between the lower and upper part of the room would be trying, as would also the contrast between the lighted lamp filament and the upper part of the room. In fact, I know of no more trying combination on the eyes than opaque reflectors placed high enough so that the lamps are visible and the ceilings are very dark. The contrast is almost blinding.

I have brought up this example not because any of you would dream of equiping a room of this kind with reflectors which would throw all of the light downward, but to bring forcibly before us the question of how much light we should spend upon ceilings and walls and how much should be directed downward in the majority of cases with which we have to deal in practice. It is evident that there must be a certain satisfactory proportion. Illuminating engineering experience and measurements of the past two years have demonstrated that in the majority of rooms, both large and small, comfortable and efficient results are obtained when from 25 to 35 per cent of the total light produced is directed toward the ceilings and walls, leaving 65 to 75 per cent to be directed downward for the direct use of the persons in the room. There are, of course, many exceptional cases where for special reasons more illumination is wanted on ceilings and walls. However, this relative proportion will sufficiently bring out any decorations on walls and ceilings and will at the same time keep the illumination on walls and ceilings at low enough intensity so that the lower part of the room will seem well lighted to the persons reading or working therein.

In the great majority of cases where a room is inefficiently lighted it is because more than 65 to 75 per cent of the total light produced is directed toward walls and ceilings. Some people have become so used to having walls and ceilings highly illuminated that they think it is necessary to deliver a larger proportion of light there than is obtained in daylight illumination from windows. In the daytime the lower part of a room is almost invariably illuminated to a higher degree than the upper part, and we accept this condition as a matter of course. As soon as artificial light is turned on, however, the conditions will be reversed; that is, the upper part of the room will be illuminated more than the lower part if we place our lamps high and do not make proper provision for directing the light downward.

Starting out with the assumption that we wish to direct from 65 to 75 per cent of our total light downward, how do various modern lamps and reflectors conform to these requirements? Without going into details, it may be said in a general way that all incandescent lamps if hung pendant and equipped with scientifically designed opal or prismatic reflectors which come down even with the tip of the lamp will give us these results. The Nernst lamp as ordinarily equipped with opaline or sand-blasted globe, also gives these results, usually giving a little larger percentages of its light below 75 deg. from the vertical

than do incandescent lamps with reflectors. To be more specific, let us consider the reflectors for the large Gem and tungsten lamps which have been produced. The bowl type of reflector, which has been made for some time by manufacturers of prismatic reflectors and which has recently become obtainable in opal glassware as well, gives the percentage of downward light specified. The bowl type is especially good because it covers the lamp filament and so protects the eye. The flat or nearly flat opal and prismatic reflectors do not conform to these requirements and will probably gradually be discontinued for general illumination purposes, both because they expose the lamp filament to the eye and because they allow entirely too large a percentage of the total light to be thrown out horizontally where it strikes the walls and is thus reflected back and forth between the walls many times without any large percentage of it reaching the lower part of the room. We can safely lay it down as a general principle that any incandescent lamp reflector which will not intercept and reflect a large proportion of the light given out horizontally is not adapted to the majority of cases of general lighting. It is neither efficient, pleasing in appearance nor comfortable to the eye. The great bulk of the scientifically designed incandescent lighting in the next few years will undoubtedly be done with two classes of reflectors, one of which is the deep bell type as we have it on the market to-day in opal, prismatic, enameled and sand-blasted glassware. The other is the deep concentrating type. The shallow concentrating reflectors which have been used with Gem lamps will probably be replaced with deeper reflectors for reasons of efficiency and appearance.

We may now consider briefly the fields for these two types of reflectors. The concentrating reflector, it almost goes without saying, could be used wherever most of the illumination from a lamp is wanted over a small area. For example, if we wish to place our lamps high and illuminate a few desks without illuminating the surrounding parts of the room, we must use concentrating reflectors. If we place a lamp high up in the center of a living room in a residence and it is not of sufficient candle-power to illuminate the entire room so that reading can be done anywhere in the room, we can secure a reading area in the center of the room by the use of a concentrating reflector. For the general illuminating of very large interiors such as large stores and offices, we may successfully use either concentrating or bowl types of reflectors with no great difference in the results, provided we have lamps spaced at frequent intervals. In the case of a large room, if we use bowl reflectors, each lamp and reflector delivers about 65 per cent of its light within 75 deg. of a vertical line through the lamp axis. Now in a large store or office, light given off anywhere below 75 deg. will, most of it, strike the working plane of the counters or desks before it reaches a wall. Therefore, it will be directly utilized, although the area covered by each lamp will be large. If we use concentrating reflectors in the same large room, the area covered by each lamp will be smaller and the illumination at any point will depend more upon the nearest lamps than if bowl reflectors were used. The total results, however, will not be greatly different.

In the case of a long, narrow store, it may make considerable difference if concentrating or bowl reflectors are used. Take, for example, a case frequently met, namely, a store 25 ft. wide with a row of outlets over each counter. It is always desirable to place the lamps high. If we place bowl reflectors at these outlets near the ceiling, a considerable amount of light will be directed toward the upper walls. Should the walls or shelves be dark in color, such light would be largely lost. The bowl reflector gives a large flux of light in the neighborhood of 45 deg. from the vertical and a part of this flux strikes the high sidewall with the bowl reflector placed as near the wall as it would be if hung over the counter. Therefore, if we are to illuminate efficiently a store of this kind with lamps placed high with a row over each counter about 6 ft. from each side wall, we must use concentrating reflectors. The same store could be lighted with bowl reflectors by placing a row of lamps down the middle of the store. The bowl reflectors, each covering a large area, would throw a large amount toward each counter and the lower shelves.

I have so far dealt with conditions where it is desired to obtain large illumination on a desk or counter level, depending mainly on light received directly from the lamps and reflectors, supplementing this only with a small amount received from ceilings and walls. An interesting and fascinating field for study is that of indirect lighting where most of the light received in a room for useful purposes comes from the ceiling by diffuse reflection from concealed lamps. Indirect lighting systems have never gained a strong foothold for the reason that they are so dependent upon the cleanliness of the ceilings or walls, which act as reflectors, and the concealed lamps are frequently neglected and allowed to become so covered with dirt that the efficiency is further much interfered with. Such systems have also frequently been handicapped by poor illuminating design. If indirect lighting is ever to become successful it must be so designed that most of the useful light does not have to undergo more than one reflection from the ceiling or wall after leaving the lamp and its reflector. The loss is considerable at best, and we cannot afford to handicap a system which is inherently more expensive than a direct-lighting system by a lot of unnecessary losses. There is no question but that the illumination received from large surfaces is more agreeable to the eye than that received from points. We have this illustrated in daylight when light is received through windows by reflection from the sky.

As the art of illuminating engineering progresses many short-cut methods are being worked out whereby the work of making calculations is much reduced. I would call your special attention to a table recently compiled by Mr. V. R. Lansingh and myself and published in the Electrical World of July 11, 1908, page 89, copies of which have been distributed among you. With this table it is only necessary to perform a couple of multiplications to get the total watts required to illuminate a given room to a given average intensity in foot-candles. In the lighting of any large room, the first question, of course, to be decided is how many foot-candles illumination is needed. Modern large stores in practice have counter illumination from 2 to 6 foot-candles. Most customers would consider 3 foot-candles excellent and ample. The majority of people like 2 foot-candles for reading, although thousands undoubtedly read with a lower illumination than this habitually. People whose eyesight is beginning to fail usually require much higher illumination than younger persons. For general illumination in drafting rooms where no special lighting is provided, 10 foot-candles is none too much. Referring to the application of the table, it is only necessary to multiply the figure given in the table for a given condition by the average foot-candle illumination which is wanted. The result will be the watts per square foot required to give that illumination.

Progressive Work by a Contractor.

The work of canvassing residence districts for possible electric lighting customers has so far been carried on mainly by central-station companies. Recently, however, it has become apparent that contractors can profitably exert some effort in this line. A notable move of this nature has been made by the Sanborn-Marsh Electric Company, of Indianapolis, Ind. This company has two solicitors whose ostensible business it is to canvass the residence districts to sell electric flatirons. Besides taking orders for irons, however, they learn incidentally whether the house is wired for electric service, whether the service is being used, if the house is wired, or whether the house is wired, but fixtures are not hung. This information is placed on a card and kept for reference in future efforts to get the wiring of unwired houses or the completion of electric wiring jobs where the fixtures have not been hung. Mr. Sanborn, president of the company, says that there are many houses in Indianapolis owned by persons who can afford to have them wired, but that the wiring has not been done, largely because of an impression that the wiring of an old house creates a terrible

mess and does considerable damage to the house. This company is attempting, therefore, to give practical demonstration in its daily work of the neatness with which an old house can be wired. Careful, gentlemanly workmen are employed, who make as little confusion as possible and clean up after themselves, leaving things in as good condition as they find them.

LETTERS TO THE EDITORS.

Method of Testing Transformers.

To the Editors of Electrical World:

SIRS:—The method of testing transformers described by Mr. W. M. Hollis in your first issue of May is not new. This method was described in my book "Tests of Direct-current and Alternating-current Apparatus" published last year.

PARIS, France. PAUL BOURGUIGNON.

To the Editors of Electrical World:

SIRS:—It seems to me that the method illustrated in Fig. 4 of the article by Mr. W. M. Hollis in your first issue of May is essentially the method described by my former assistant, Dr. Sumpner, and myself before the British Association on Aug. 5, 1892—that is, 16 years ago—and which method has been in very extensive use in this and many other countries.

The essence of our method for testing a transformer resembles the method that Dr. Sumpner and I previously published before the Institution of Electrical Engineers, for testing an alternator, and the whole was suggested by Hopkinson's world-wide method of testing two dynamos which were coupled up so that one was acting as a dynamo and was driven by the other which was acting as a motor, the loss of power of the two being supplied by storage batteries.

I may mention that our method of testing an alternator consisted in coupling up half an alternator to act as a generator and the other half as a motor. In fact, although Mr. Hollis does not make this point clear in his article in the ELECTRICAL WORLD, the late Dr. Hopkinson's and our methods involved the use of a machine (direct-current dynamo—half an alternator—or one transformer) supplying electric energy to its mate and receiving electric energy in return from its mate, that taken from the electric mains representing merely the loss in the combination.

LONDON, England. W. E. AYRTON.

[The article by Mr. Hollister contained an outline of approved methods of testing transformers for which no originality was claimed by the writer.—EDS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Direct-Current Machines.—An illustrated article on tests of some large direct-current machines made for the British War Department. There are 14 shunt-wound main poles, and an equal number of commutating poles, through the windings of which the whole load current of the machine passes in series. Each machine is designated to give 2900 amp continuously at from 500 to 530 volts, or 1500 kw, when driven at 85 r.p.m. The specified temperature rise of the hottest available part after 12 hours' run on full load was to be not more than 70 deg. F. (39 deg. C.), and the efficiency not less than 93 per cent by the Hopkinson test. The specified overload capacity was 25 per cent for two hours. These specified figures were more than fulfilled on test, the temperature coming out very low, and the efficiency 94 per cent. The test of these machines brought out very clearly the fact that the sum of the no-load losses plus the additional C^2r losses due to the load do not make up the total power loss at full load. The serious nature of this error

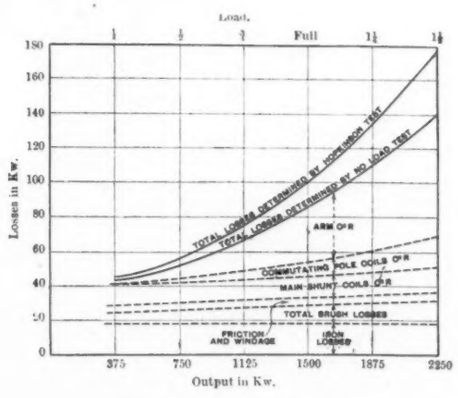


FIG. 1.—MACHINE LOSSES.

is illustrated in Fig. 1, in which the upper curve represents the total losses as given by the Hopkinson test, and the lower curve the total losses as obtained from a no-load test. In the lower curve of Fig. 1, half the losses supplied from external sources are plotted against the mean load of the coupled machine, as found from the Hopkinson test. The discrepancy in the efficiency as obtained by these two methods is very considerable, as may be gathered from the following table:

Load.	Efficiency by Hopkinson test.	Efficiency by no-load test.
50 per cent overload	93%	94.5%
Full load	94%	95%
Three-quarter load	94%	94.8%
Half-load	93%	93.8%
Quarter-load	89.5%	90.2%

—Lond., *Electrician, Elec. Rev., Elec. Eng.,* July 3.

Pole Design.—P. GIRAULT.—The eddy-current losses in the periphery of armatures may become of importance at the high tangential speeds now used, for example, with turbo-generators. The author investigates mathematically how to design the pole masses in order to make the eddy-current losses in the armature teeth a minimum, for a given flux emanating from each pole. He shows that the induction in the air-gap must vary according to a parabolic law, but that a sinusoidal law leads almost to the same results. Similar considerations may be made with respect to eddy-current losses in transformers.—*La Lumière Elec.,* June 13.

Lamps and Lighting.

Electricity and Gas.—J. D. MACKENZIE.—The conclusion of his article on supply of electricity or gas to small consumers. The possibilities of electric lighting with metallic-filament lamps are pointed out, but with small consumers it is also necessary to reduce the wiring cost. The author favors the system of flexible wire spaced on small porcelain insulators fixed to walls and ceilings which is used to a large extent in continental Europe. While this system may be dangerous with high voltages the author recommends the use of his metallic-filament lamps at 25 volts. Details are given as to wiring and as to construction of the auto transformer.—Lond. *Elec. Rev.,* July 10.

Lamp Testing.—An article on the lamp testing room of a British company describing briefly the arrangements for testing for vacuum and for mechanical defects, and photometric tests. The photometer is of the Simmance-Abady type, the secondary light standard being of the Fleming pattern. This latter is calibrated against the standard lamp before the commencement of each test.—Lond. *Elec.,* July 3.

Power.

Generating Station at a Coal Mine.—L. PASCHING.—An illustrated description of the Castelnuovo-Valdarno power station in Italy. There are extended deposits of lignite there available

but the transport and sale of the lignite could not be rendered profitable because it contained from 40 to 50 per cent of water. It was therefore decided to erect a generating station at the mine itself and to transport electrical energy to points in the neighborhood. There are three 2400-hp generating sets producing three-phase currents at 6000 volts. At present there are five transmission lines going out of the station, the transmission voltage being 33,000.—*Elek. u. Masch.*, June 14 and 21.

Steam and Water Power Plant.—C. M. Shaw.—A paper read before the Brit. Municipal Elec. Assoc. on "the reconstruction of an electric lighting scheme with observations on the working of a combined steam and water power plant." The plant referred to is at Worcester. The original single-phase plant was essentially a water power station. The steam plant, which was looked on as purely auxiliary, was put down without any regard to economy. When a large traction road appeared later on, a new central steam-driven station supplying continuous current was erected and was so interconnected by means of a storage battery and a motor-generator with the alternating-current water power plant that use could be made of the surplus water supply. The old steam plant at the water power station was scrapped. The financial regeneration of the station has been due mostly to the reduction of the capital charges per units sold, by so altering the system and the charges that a large power load was created. Not only did this power load cheapen the cost but since in this instance water power was employed which otherwise would have run to waste a further economy was obtained.—Lond. *Elec.*, July 3; *Elec. Eng'ing*, July 9, and *Elec. Rev.*, July 10.

Coaling Warships at Sea.—An illustrated description of the Adam system for coaling warships at sea, shown at the recent German Shipbuilding Exposition. The principle of this system is shown diagrammatically in Fig. 2, in which the warship is

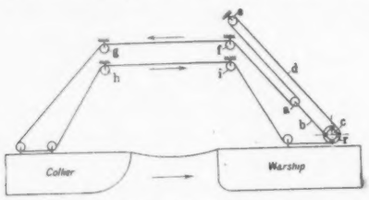


FIG. 2.—DIAGRAM OF COALING SYSTEM.

assumed to be tugging the collier by means of a hawser. The endless cable *d* is carried round the cable sheave *r*, which keeps it in motion, and also round the pulleys *e*, *f*, *g*, *h*, *i*, the tension pulley *a*, and the pulleys fixed to the decks of the two ships. The cable sheave *r* is mechanically coupled to the magnet system of the motor, and the cable is kept continuously moving in the direction indicated by the arrows. Both the field magnet system and the armature of the motor are capable of rotation, as can be seen from Fig. 3, which shows the motor

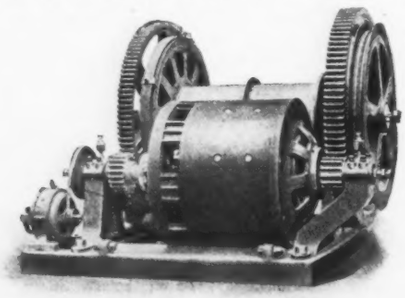


FIG. 3.—COALING WINCH.

with cable sheave and drum complete. The pinion on the right of the figure is connected to the magnet system, and drives the cable sheave, while the pinion on the left is connected to the armature and drives the drum *c*. To this drum is attached one end of the tension rope *b*, the other end being fixed to the tension pulley *a*. When the motor is switched on, the magnet system rotates, keeping the endless cable moving. The armature exerts a definite torque and rotates in the opposite direction, winding in the tension rope *b* until the pull on this is equal to the torque of the armature. If the distance between the ships increases, the pull on the tension rope overcomes the torque of the armature, and some of the rope is unwound. If, on the other hand, the ships approach one another, more of the rope is taken in, and so the endless cable is kept at a fairly constant tension. These actions are quite automatic, and the apparatus responds quickly to alterations in the distance between the ships. Where the cable leaves the ship it passes through a fixed metal cone (coming out at the apex of the cone). A running noose made from a loop of stout cord is slipped over the cone and attached by means of a small iron hook to the full or empty sack, according to whether the cable is leaving the coaling vessel or the warship. The sack is pushed forward and the noose slips off the cone on to the cable. The weight of the sack draws the noose tight and the sack is carried along to the other ship. The cable is drawn so tight round the pulleys that when the sacks pass the pulleys there is no chance of the cable being pulled off. At the receiving end, the cord supporting the sack is cut by two knife edges just before the sack touches the deck.—*Lond. Elec. Eng'ing*, July 2.

Electricity in Mining.—Almost the complete issue is devoted to a discussion of the different applications of electricity in mining, with descriptions of the various kinds of electrical machinery used in mines. There are articles by W. S. Toplis, giving a general survey of electric power applied to mining, by R. Herzfeld on electric pumping, by T. C. Futers on electric winding, by R. Livingstone on energy calculations in coal winding, by W. C. Mountain on electric haulage in mines, by F. W. Hurd on electric coal cutting machines, by W. Maurice on the employment of storage batteries in colliery power stations, by G. C. Allingham on fly-wheels vs. storage batteries for equalizing fluctuating loads, by H. W. Clothier on switch gears for mines, by J. H. C. Brooking on mine cables, by F. Hird on electrical signals in mines, by J. W. Gibson on ventilation of mines by electric fans, and by W. Maurice on the use of explosives in coal mines.—Lond. *Elec.*, July 10.

Design of Generating Stations.—H. Richardson.—A paper read before the Brit. Municipal Elec. Assn. in which the author discussed various matters relating to the construction and working of generating stations. He favored reinforced concrete piles for foundations, and steel skeleton buildings with either light brickwork filling, or corrugated iron walls and roofs, and he compared brick, concrete and steel chimneys to the disadvantage of the last-named. In the discussion of the paper S. L. Pearce referred to the possibility of employing gas engines in conjunction with steam turbines, the former supplying the mean load and the latter the peaks. He has looked into the matter for Manchester and is in favor of putting in one or two gas engines and keeping them running the whole 24 hours, leaving the rest to the steam turbine and reciprocating plant.—Lond. *Elec.*, July 3; Lond. *Elec. Eng'ing*, July 9; Lond. *Elec. Rev.* and *Elec. Eng.*, July 10.

Condensers for Steam Turbines.—M. Leblanc.—An article on the principles of pumps and condensers, especially for use in connection with steam turbines. He describes a new air pump invented by him.—*La Lumière Elec.*, June 13, 20, July 4.

Traction.

Single-Phase Railway.—O. Allen.—An illustrated description of the single-phase railway in the Brembana Valley in Northern Italy which was built by the French Westinghouse Company. A comparison between the costs of direct-current and single-phase equipments shows that the first cost of the latter is at least 25 per cent less. Water power is utilized to generate the 6000-volt, 25-period, single-phase current. Five electric locomotives are provided, each equipped with four 75-hp motors.—*La Lumière Elec.*, June 13, 20.

Surface Contact System.—An illustrated article on the Griffith-Bedell surface contact system which is in use on a section of a line in London. While the cost of installation was considerably less than for a conduit system, yet it exceeded, although not greatly, that of the overhead trolley. The principal

feature of the system is the provision under the studs in the road of a bare feeder cable partly of magnetic material supported on insulators in an earthenware pipe. The body of each stud contains a plunger normally held up by a spring, which, however, becomes magnetic and attracts itself down to the cable and makes contact with it when the powerful magnet on the car passes over it. The heads of the studs are of cast iron, and are sunk into granite blocks, so that they do not project appreciably above the surface of the roadway. The action of the flexible chain which forms the actual collector on the car is somewhat similar to that of the plunger within the stud. Lying normally clear of the road surface in a groove in the surface of the wide pole face of the car magnet, it is attracted down to the iron stud-head and makes contact as it passes over. The plungers in the studs are provided with carbon contacts, although they are not usually required to break the circuit, as the studs are so spaced that the collector does not leave one stud before it has made contact with the next in front.—*Lond. Elec. Eng'ing,* July 2.

Electric Traction.—P. DAWSON.—A continuation of his long serial on electric traction on railways. In the present installment the author makes a comparison between direct-current, three-phase and single-phase systems, giving in tables particulars of various different equipments. The following table gives specific data of five single-phase motors of various makes, and shows what difference exists between them.

	Make of motor.				
	A	B	C	D	E
Rating for one hour of motor in hp.....	100	120	100	120	150
Flashing tests in volts.	12,000 and 2,000	12,000 and 1,000	2,500	12,000 and 2,500	2,500
Number of brushes per motor	6 sets of 5 brushes	5 pairs	3 pairs	3 pairs	6 pairs
Thickness of brushes..	⅜″	0.35″	0.375″	⅜″	½″
Normal current density in brushes in amperes per square inch....	38.5	45	40	25	65
Air gap in millimeters	1.75	4	2	3	4
Average volts per commutator segment ...	12	..	4.8	3.38	..
Reactance volts per commutator segment	2.2	2.5	1	4	..
Normal speed in r.p.m.	550	550	840	600	700
Weight of rotor in cwt.	22.7	26	18	20	13.4
Weight of stator in cwt.	26.6	23	40	28.5	34.8
Combined weight of stator and rotor....	49.3	59	58	48.5	48.2
Temperature rise after one hour run rated load with open cover in deg. F.....	135 Com. 160	140	Com. 180	135	135
Efficiency of motor and gear at rated load...	77¼%	77%	77%	79½%	79%
No. of poles of motor.	6	8	6	4	6

In his comparison of the different systems, the author emphasizes that given certain types of apparatus and certain makers, the very large difference which is claimed to exist between the weight of continuous-current, three-phase and single-phase apparatus very largely disappears. Since there is so large a difference already in existence between different continuous-current machinery as manufactured by different makers and operated by different lines, it is not necessary to conclude that all single-phase equipments must greatly exceed in weight all equivalent continuous-current plant.—Lond. *Elec.,* July 3.

Electric Cabs.—An article stating that a service of electric taximeter cabs is to be established in London. One hundred cabs are to be installed first.—Lond. *Elec. Eng'ing,* July 9.

Installations, Systems and Appliances.

Storage Batteries for Peak Loads.—A. M. TAYLOR.—A Municipal Elec. Assn. paper. After referring to the very extensive use of accumulators in America and in Germany, the author considers the possibility of putting in accumulators instead of a generating plant to deal with the peak load of a station as the output increases from year to year. He considers a special case in which the maximum load increases over a period of five years from 5000 kw to 10,000 kw, it being proposed to deal with this increased load entirely by means of accumulators. The author endeavors to show that there is a possibility of materially lower costs, and he advocates the use of batteries for such a purpose, even in the case of alternate-current substations. The paper contains a great many curves and tables to show that his policy should be economical, but his argument was attacked by the central station engineers taking part in the discussion.—Lond. *Elec.,* July 10, and Lond. *Elec. Eng'ing,* July 9.

Wires, Wiring and Conduits.

Calculating Wiring Networks.—G. MATTAUSCH.—There are quite a number of different methods for calculating wiring networks, namely those of Herzog and Stark, Coltri, Teichmuüller, Frick, and Kennelly. The author endeavors to combine the best features of these different methods into a new method and explains the application of this new method by a simple example.—*Elek. u. Masch.,* June 15.

Electrophysics and Magnetism.

Point Discharge.—A. P. CHATTOCK and A. M. TYNDALL.—An experimental investigation of the changes of pressure which accompany point discharge through hydrogen containing oxygen and nitrogen. The chief results are as follows: Oxygen present in hydrogen at atmospheric pressure and subjected to point discharge, combines with the hydrogen at the rate of about 16 molecules of oxygen per ion for positive and 25 molecules for negative between the percentages 2 and 14 by volume for the particular point used. Below 2 per cent, the combination for negative rises rapidly until it may reach as many as 110 molecules per ion below 0.01 per cent. Below 0.2 per cent of oxygen the combination for positive is about constant, and roughly equal to 10 molecules per ion. There is evidence that at least 90 per cent of the oxygen can be caused to combine with the hydrogen by point discharge. The presence of one part of oxygen and upward in ten million of hydrogen can be detected and roughly measured by this method. The maximum contraction producible is about 2.8 times greater than the volume of the oxygen present when the water-vapor is allowed to remain in the discharge vessel. When nitrogen is present with oxygen in hydrogen, even in enormous excess, the combination that occurs is mainly, and perhaps wholly, between the oxygen and the hydrogen. About 7 per cent of the contraction occurs after the discharge has ceased. There is evidence which suggests that the addition of oxygen above 0.01 per cent increases the size of the negative ions; while its effect on the positive ions is inappreciable. In pure hydrogen the contraction corresponds to about 1 molecule per ion.—*Phil. Mag.,* July.

Discharge from an Electrified Point.—R. F. EARHART.—An experimental investigation on the discharge from an electrified point and the nature of the discharge occurring through very small distances. Recent experiments have shown that there is a minimum value for potentials required to produce an ionization of air or other gas between the electrodes, due to the field itself as the ionizing agent. This might be called the least ionizing potential. Its value for air has been determined by several observers as 350 volts. The author has investigated the discharge between a point and a plane and his results are as follows: The least ionizing potential for point and plane is about 338 volts in air; a value some 12 volts less than between plane surfaces. The critical distance is greater for point and plane than between plane electrodes. The critical potential is less for a negatively electrified point than for a positive point. The gradient for discharge occurring for potential-differences less than the least ionizing potential is steeper in the case of point and plane than for plane electrodes and is independent of the polarity of the point. The carriers for a discharge produced by potential differences less than the least ionizing potential are not always negative corpuscles.—*Phil. Mag.,* July.

Resistance of Conductor.—C. H. LEES.—An abstract of a (Brit.) Phys. Soc'y paper on the resistance of a conductor of uniform thickness whose breadth suddenly changes and on the shape of the stream lines. A knowledge of the resistance of a conductor whose section suddenly changes is of considerable practical importance, but mathematical difficulties have prevented an exact solution of the problem. Lord Rayleigh has given an approximate solution of the case in which a cylinder of circular section is joined at one end to the plane surface of a large conducting solid; and Hicks has solved the case of a wire of small diameter ending in the surface of a conducting sphere. The mathematical difficulties of the problem disappear

if the conductors are of rectangular section and one dimension, e. g., the thickness, remains constant while the breadth suddenly changes and the two are joined together either with their axes or with two sides collinear. The paper shows that the resistance between two transverse sections through points situated at considerable distance from the change of section on opposite sides of it is equal to the sum of the resistances of the portions of conductor between each of the two sections and the change of section, each considered as part of an infinite length, plus the resistance of a length of either conductor equal to its breadth multiplied by an expression given.—Lond. *Elec.*, July 3.

Decomposition of Steam by Sparks.—A. Holt and E. Hopkinson.—The decomposition of a compound gas such as water-vapor or carbon dioxide by electric sparks, and the separation and arrangement of the resulting products about the electrodes, is of special interest since it may be expected to show how far the hypothesis of electrolysis in liquids is applicable to gases. The experiments of the authors lead indeed to the conclusion that when electric sparks pass through a compound gas such as water-vapor or carbon dioxide, the separation and arrangement of the decomposition products is not an electrical phenomenon, but results from gaseous diffusion. The hypothesis of electrolysis in liquids is therefore inapplicable.—*Phil. Mag.*, July.

Conductivity of Cuprous Iodide.—K. Baedeker.—A note on a peculiar form of electric conductivity in a solid. Cuprous iodide, when pure, is a very poor conductor of electricity, but when subjected to the action of free iodine, it gets a conductivity about 100 times that of sulphuric acid at maximum conductivity. A small quantity of iodine is thereby absorbed. The phenomenon is reversible and may be reproduced as often as desired.—*Phys. Zeit.*, July 1.

Inductance.—J. W. Nicholson.—A brief abstract of the Brit. Phys. Soc'y paper of apparently highly mathematical nature on the inductance of two parallel wires.—*Lond. Elec.*, July 3.

Electrochemistry and Batteries.

Charging Batteries.—E. Bäumer.—An article in which the author suggests the use of iron resistances for regulating the current when charging storage batteries. It is well known how rapidly the electrical resistance of iron increases as the temperature is raised. In order to overcome the difficulty in charging accumulators, due to back e.m.f. as the charging proceeds, the author uses iron wire of such a size that when the initial current is passed it is kept at a low red heat. As the cell e.m.f. increases during charge, the current passing through the wire is less, therefore its temperature falls, and it now becomes a better conductor.—*Centralblatt f. Accum.*, June 20; abstracted in Lond. *Elec. Eng'ing*, July 2.

Cyanamide.—A. Frank.—An abstract of a Faraday Society paper on the utilization of atmospheric nitrogen in the production of calcium cyanamide and its use in agriculture and chemistry. The Frank-Caro process is briefly described and the following notes are given on its industrial developments. The first works established for producing and selling 3000 to 4000 tons a year, working for the last three years, were in Italy, at Piano d'Orte (Abruzzi), and are now being enlarged for an output of 10,000 tons. Another works is just being erected at San Marcel (Val d'Aosta) for another 4000 tons, and the great Terni carbide works are laying themselves out for the production of some 10,000 tons in the near future. Dalmatia has followed the Italian example at Sevenico, at Fiume (each for an initial 4000 tons), and at Almissa, where 50,000 hp are available, and a further 10,000 tons output is being planned, all the product being required in the Balkans, Hungary and the Mediterranean coast of Africa and Egypt.—Lond. *Elec.*, July 10.

Prevention of Rust.—Thornton-Murray.—A note on a paper read before the Birmingham University Metallurgical Society. The author first dealt with the theories of rust. It was once considered to be due to chemical action, carbon dioxide and water being necessary for its occurrence, and the compound formed having the formula $2\,Fe_2\,O_3\,.3H_2O$. This supposition has to some extent been modified by the more recent electrolytic theory which considers that the action is mainly promoted by irregularities in the metallic surface, though the presence of carbon dioxide and water greatly facilitates matters. Turning to the prevention of rust, the author briefly described the various methods employed for this purpose, including tinning and galvanizing, and showed that, of the different varieties of iron, some resist rusting action to a greater extent than others. In conclusion he mentioned a method, due to T. Corlett, of Birmingham, which consists in immersing the article in a hot solution of some phosphate and an iron compound. This covers the metal surface with a mixture of ferrous and ferric phosphates, and presents a pleasing dull black appearance. The process, it is said, makes the iron highly resistant to corrosion and is adapted for light engineering work, such as cycle frames, gun barrels, stampings and press work.—Lond. *Elec.*, July 3.

Oxy-Acetylene Burner.—J. B. von Brussel.—An illustrated article on new processes for metal cutting and autogenous welding, with the oxy-acetylene blowpipe. Another article by C. R. King gives time and cost data of this welding process as used in European locomotive shops.—*Eng. Mag.*, July.

Units, Measurements and Instruments.

Protective Device for Meters.—J. Busch.—The author has observed numerous cases in which meters had been destroyed by atmospheric discharges. This is especially the case with watt-hour meters of smaller size, on account of their relatively high self-induction. To protect them the author now uses a spark-gap through which the discharge passes more easily than through the meter coil. Fig. 4 shows the arrangement. *L* is

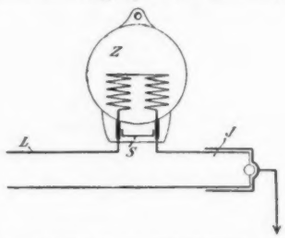


FIG. 4.—DIAGRAM OF PROTECTIVE DEVICE.

the line; *Z* the meter and *J* the installation. A metallic strip or wire *S* is placed between the two terminals of the meter coil; the two ends of the strip making contact with the terminals of the meter are pasted with thin paper. The atmospheric discharge passes more easily through the paper than through the coil of the meter. The arrangement is said to have proved successful in practice in the last 18 months.—*Elek. Zeit.*, July 9.

Testing Department of Central Station.—H. A. Ratcliff.—A paper read before the British Municipal Electrical Association, in which the author gives a collection of notes on various features of practical interest in connection with the testing department of a central station. Suggestions are made regarding the necessary equipment and the supply and regulation of the current required, and an interesting "phase shifter" for altering the power factor in alternating-current testing circuits and devices in connection with main tests are also described. The paper also deals with meter testing, photometry, fault localization, etc.—Lond. *Elec.*, July 10, and Lond. *Elec. Eng'ing*, July 9.

Telegraphy, Telephony and Signals.

Microphone Records.—Devaux Charbonnel.—An account of an experimental investigation with reference to telephone transmission. An oscillograph was put in circuit with a microphone and a battery, and the curves traced by it were enlarged by projection. The French vowel sounds were chiefly studied. The vowel "ah" was found to consist of the first, second, fourth and sixth harmonics, with amplitudes 1.0, 1.7, 3.0 and 4.8, respectively, and phase displacements of 0 deg., 90 deg., 90 deg. and — 90 deg., respectively. "Oh" consists of the first, third and fifth harmonics; "eh" of the first, second and twelfth; French "u" of the first, second and ninth, and English "ee" of the first, second and thirteenth, with amplitudes in the last case of 1.0, 4.2 and 2.8 and phase displacements of 0 deg., 0 deg. and 90 deg., respectively. The twelfth and thirteenth harmonics in the above list appear to be damped. If a number of vowels are pronounced in succession, each vowel takes about five vibrations

to attain its complete curve, and another five on terminating. Since one cannot easily pronounce more than 10 syllables per second, each vowel has about 10 clear vibrations to itself. These must be ensured before we can obtain clear transmission; and experience has shown the importance of clear vowels for the intelligibility of the message.—*Comptes Rendus,* June 15, abstracted in Lond. *Elec. Eng'ing,* July 2.

Miscellaneous.

Protective Device for Meters.—J. BUSCH.—An abstract of a paper presented before the German Assoc. Elec. Eng., in which the author explained the production of an excessive voltage in a meter due to its self-induction in combination with the capacity of the installation. Such an excessive voltage often results in the destruction of the meter, but may be prevented by shunting the induction by a spark-gap.—*Elek. Zeit.,* June 25.

BOOK REVIEW.

TELEPHONE LAW: The Organization and Operation of Telephone Companies. By A. H. McMillan. New York: McGraw Publishing Company. 331 pp. Price, $3.

The author of this work is the legal editor of the *American Telephone Journal* and in connection with such duties has given special attention for four years past to the law relating to telephone companies. It is intended for those who are actually engaged in the telephone field, and who find themselves confronted constantly by new questions and problems involving legal points. The topics have been grouped under various heads, so that each chapter deals with a specific subject, such as organization, charter, keeping records, by-laws and regulations, franchises, rates, rights of way, eminent domain, location of poles and wires, respective rights of telephone and other public service corporations, underground wires, cutting trees, financial methods, taxation, damages, contracts, insurance, etc. It will be seen that a wide range of subjects is covered; and in each case the pith of the law and of the rulings upon it is given. One matter to which especial attention is paid is that of the States in which telephone lines on the highway are held to be an additional burden upon the abutting property. In this connection Mr. McMillan has endeavored to give a decision, or reference thereto, for each State that has had a judicial ruling on the point.

This excellent work will be found of use by others than telephonists and may be heartily commended.

NEW APPARATUS AND APPLIANCES

Flame Arc Lamps.

BY W. H. JONES.

Foremost among the recent achievements in arc-lamp design and manufacture stands the flaming-arc lamp, in which the light-giving efficiency shows a marked increase over all other sources of artificial illumination. That this type of lamp has made for itself a pre-eminent position is clearly shown by the quantities that have been imported from foreign countries and the efforts made by American manufacturers to produce a lamp equally as efficient as the foreign product and at a lower cost to the public. The better known types are usually operated two in series on either alternating-current or direct-current 110-volt circuits, but they may, with the addition of a separate resistance or reactance, be operated in multiple series, with a current consumption ranging from 8 to 12 amp. Three grades of impregnated carbons are in use, namely, those giving yellow light, white light and red light. The white-light carbons produce a mellow white light, but are not very much more efficient than the old open arc lamp operated at the same current and equipped with light opal globes. The red-light carbons are second on the list as illuminants, but the term "red light" is a misnomer, as the light produced by these carbons is of a delicate pink color and not a deep red. The color of the light produced by the yellow carbons is a deep orange, remarkable for its softness, efficiency, penetrating qualities and adaptability to the ordinary range of vision.

Regarding color effects, it may be said that yellow causes the least strain on the optic nerves, because it comes in the middle of the spectrum and has a wave-length that all eyes can easily apprehend. Some eyes are better adapted or are more sensitive to the long wave-lengths of red, while others are equally as sensitive to the short wave-lengths of light blue. It has been noted that there is a definite color range for the eye, just as there is a pitch range for the ear, and in view of this it may be assumed that the yellow-light producing carbons are the most beneficial. The popularity of the yellow-light carbons is indicated by the fact that they are used in several hundred installations and constitute a large percentage of all the carbons sold for use in flame-arc lamps.

In machine shops, erecting shops, foundries and similar places having large free areas where cranes are operated it is the general practice to distribute the lamps along the sides of the building. The flame lamp, however, may be hung high in the middle of the building above the crane and still give more light than any other form of illuminant.

Regarding the extent to which it is possible to carry the impregnation of the carbon, attention might be called to research made along these lines by Mehlke, in Germany. He found it impossible in practice to increase the proportion of the addition with which the flame-arc carbons are impregnated above 6 per cent, since above that limit the light is no longer steady. He claims, however, the possibility of increasing the impregnating addition with a resulting higher efficiency if the two carbons of a direct-current flame arc are impregnated with different materials.

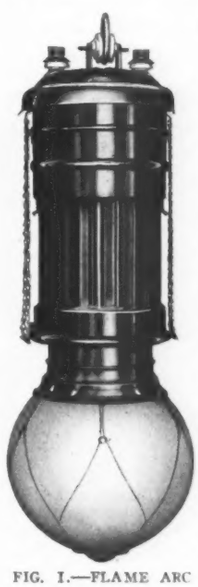


FIG. 1.—FLAME ARC LAMP.

The resistance of the arc between two pure carbon pencils at a distance of ⅛ in. is about 5 ohms, whereas if the arc is formed between two impregnated flame carbon points this distance may be increased approximately five times for the same resistance due to the fact that the gases generated act as a conducting medium.

In the pure carbon arc approximately 80 per cent of the light is emitted from the incandescent crater of the positive carbon, very little being given off by the gases formed in the negative carbon. In fact, the negative carbon cuts off a large per cent of the useful light emitted from the crater.

In flame lamps using converging carbons there is nothing whatever below the arc to obstruct the light in any way and when in operation the whole globe appears to be one luminous sphere, having no dark spots to mar the perfect harmony.

A great advantage claimed for this lamp is the fact that the light emitted is practically equal in intensity from 20 deg. below the horizontal to the vertical position (see Fig. 2, curve A), thus permitting the lamp to be hung either in a very low or a very high position and still get a perfect illumination.

When properly interpreted the photometric curve is not only a measure of light-giving value of illuminants, but also forms a useful help to their proper use. A general observation of the

area of a photometric curve is not a reliable measure of the luminous value of the source, for such comparison the mean spherical or mean hemispherical candle-power (depending on the problem) is more useful. The correct method of interpreting photometric curves in connection with a particular problem is to determine the amount and direction of light required and then select and locate the illuminant with the aid of the photometric curves.

Observation of the accompanying curves and data will show that the flame-arc lamp is more efficient in watts per candle-power than any other commercial form of electric light. Furthermore, the light is to a considerable extent concentrated be-

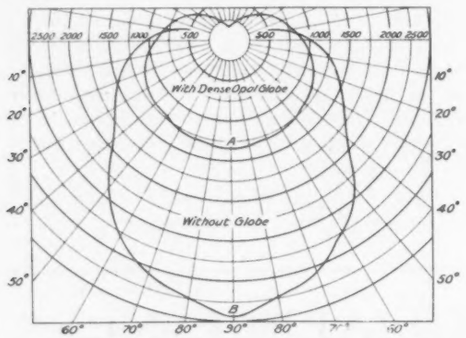


FIG. 2.—PHOTOMETRIC CURVES.

neath the lamp. The lamp is, therefore, particularly well adapted for conditions where a large volume of downward light is desired from a relatively high source. As compared to any other make of flame-arc lamp on the market, the efficiency of the G. I. lamp will be found equal to the best which, in connection with its mechanical superiority, will make it particularly attractive to the user.

This lamp, which has been developed and placed on the market by the General Electric Company, and which is shown in Fig. 1, is purely American in design, having instead of the usual clock mechanism, chain feed and escapement common to the foreign lamps, a screw feed arrangement which comprises fewer parts and is equally as efficient. This is a pronounced im-

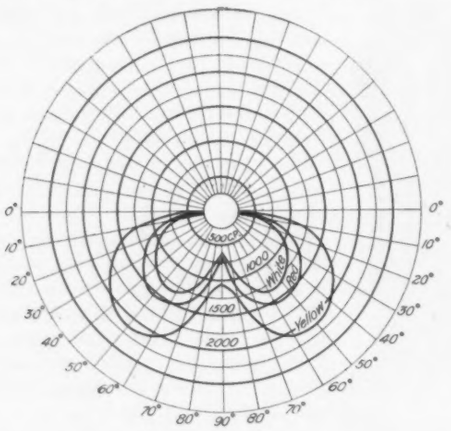


FIG. 3.—RELATIVE DISTRIBUTION OF LIGHT IN VERTICAL PLANE.

provement, since the introduction of the flame lamp in this country, and with equal efficiency and steadiness of light, gives

	Without globe		Dense opal globe	
Volts.	Arc.	Term.	Arc.	Term.
Volts	45	55	45	55
Amperes	12	12	12	12
Watts	453	500	453	500
Hemispherical cp.	1,985	1,985	1,167	1,167
Watts per m.h. cp.	.228	.252	.388	.428
Spherical cp.	1,063	1,063	874	874
Watts per m.s. cp.	.426	.47	.518	.572

the G. I. lamp a distinct advantage where maximum illumination is desired.

The photometric curves shown in Fig. 2 are the result of careful tests in the illuminating engineering laboratory of the General Electric Company.

Curve *A* indicates the average performance of the G. I. flame-arc lamp, while curve *B* shows the maximum light obtained without globes. As this is not an operative condition of the lamp, this curve is useless except for comparison with similar curves published by the manufacturers. The photometric curves were taken with the yellow-light carbons, which produce a brilliant golden-yellow light.

A table of the results obtained is given herewith.

The efficiency of this lamp is greatly increased by the use of a light opal globe. The white-light carbons give practically the same characteristic of distribution, with about 35 per cent less candle-power. They are recommended where the desirability of white light warrants the sacrifice of intensity.

The curves shown in Fig. 3 indicate the relative average distribution of light in a vertical plane of the white, red and yellow light-producing carbons.

Twenty-CP Tungsten Lamp.

Fig. 1 herewith shows a 25-watt Kuzel tungsten lamp marketed by the Efandem Company, 201 East Sixteenth Street,

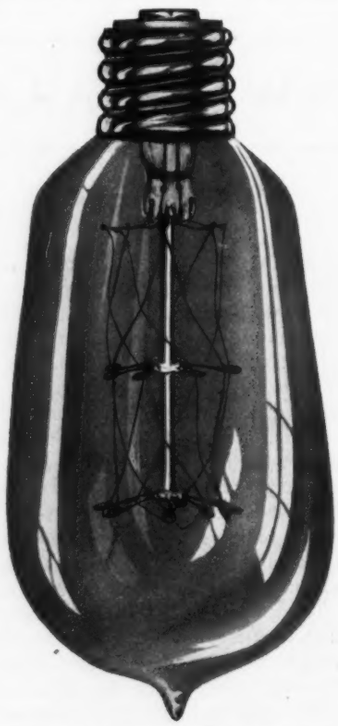


FIG. 1.—TUNGSTEN LAMP.

New York. A feature of the lamp, aside from the fact that it is the first tungsten lamp of this candle-power to appear com-

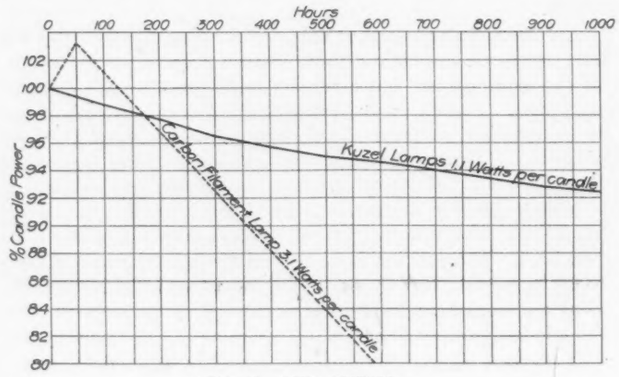


FIG. 2.—LIFE CURVES.

mercially in this country, is that it is suitable for burning in any position. By means of the eight anchors the filaments are ar-

ranged in the form of a helix which renders the lamp as rugged as the carbon-filament lamp. For many months the standard candle-power of Kuzel lamps in Europe has been 25 hefner candles and comparatively few lamps of higher candle-power have been made. The standard Kuzel lamp for this country will be for the present 20 cp (American), 25 watts for 110-volt circuits. The lamp is only slightly higher in candle-power than the ordinary carbon-filament lamp which it is designed to replace, while the energy consumption is less than half that required by the most efficient carbon-filament lamp. The life of the lamp is said to be excellent. Fig. 2 shows the average curve for 1000 hours' burning of a number of lamps taken at random from a stock of several thousand. Eighty per cent of all the lamps, it is claimed, were burning at the end of 1000 hours.

Universal Panel Boards.

Some features of the Universal panel boards made by the J. Lang Electric Company, of Chicago, are of considerable interest. These panel boards take plug fuses, and one of the essential features is the simplicity of construction in connection with the fuse plugs. Fig. 1 is a section through a fuse plug. The plug is placed directly over the busbar and makes contact with a screw protruding above the bar. This construction

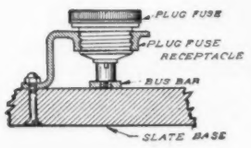


FIG. 1.—PLUG AND FUSE.

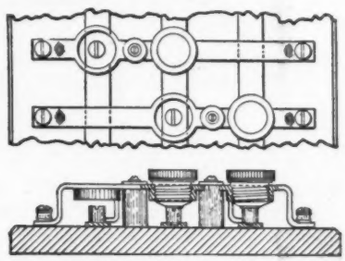


FIG. 2.—THREE-WIRE PANEL FUSE PLUG.

makes possible a narrow panel. The branch bars form a protection for the main busbars, serving to prevent short-circuits when inserting fuses. Fig. 2 is a section and plan through a three-wire panel. On account of the compactness of this arrangement, the necessary containing cabinets are smaller and cheaper. The makers claim the initial cost to be little more than that of porcelain cut-outs, while the cost of installation is less. The copper parts are highly polished and lacquered and mounted on a black enameled slate. The panel is convertible and may be used on a two or three-wire system. Each panel is fitted with a copper jumper for this purpose.

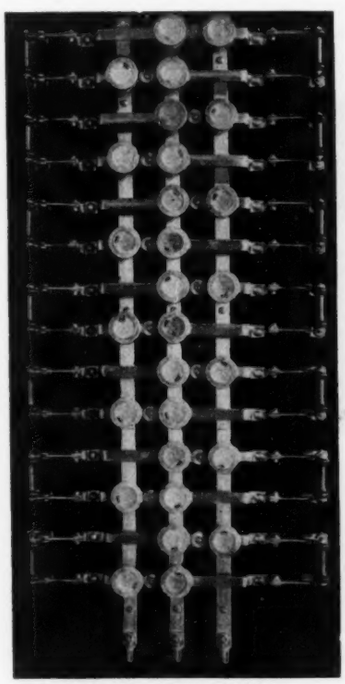


FIG. 3.—PANEL BOARD.

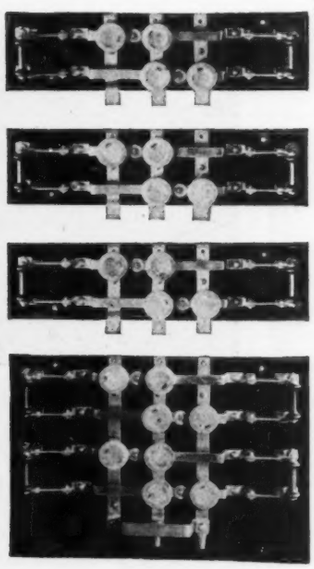


FIG. 4.—SECTIONS OF BOARD.

A panel board made up with fuses and switches for each circuit is shown in Fig. 3. It is also possible to start in with a panel board having only a few circuits, as in Fig. 4, and to add additional circuits and switches, one by one, from time to time, by bolting on extra sections as indicated in Fig. 4. When these various sections are assembled the appearance is that of one continuous panel board.

A New Seamless Trolley Pole.

A new seamless trolley pole is being put on the market by the R. D. Nuttall Company, Pittsburg, Pa. It is made of cold-drawn seamless tubing. Great strength is insured by a reinforcement at the bottom and a gradual taper at the top. The reinforcement is 16½ in. long and made of the same material as the pole proper. It is inserted cold and with such care as to fit that it practically becomes a part of the pole. The taper begins 3 ft. from the top and reduces the diameter from 1½ in. at this point to 1 in. at the end. The pole is made in all lengths up to 18 ft., and combines rigidity with light weight. The average weight of the 12-ft. pole is 22 lb.

A New Mirrored Reflector.

Fig. 1 illustrates a new shallow bowl reflector made by the National X-Ray Reflector Company, Chicago, known as No.

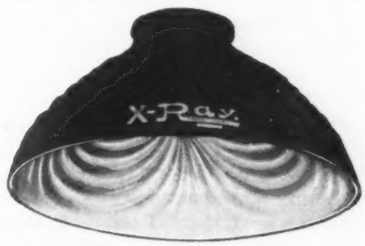


FIG. 1.—SHALLOW BOWL REFLECTOR.

550. The distribution of light about this reflector is shown on the accompanying curves, Fig. 2, from tests by the Electrical Testing Laboratories. From this it is seen that the reflector is fairly broad concentrating. Its principal use is where most of the light is wanted underneath the lamp and reflector, but it is desired to let some escape sideways.

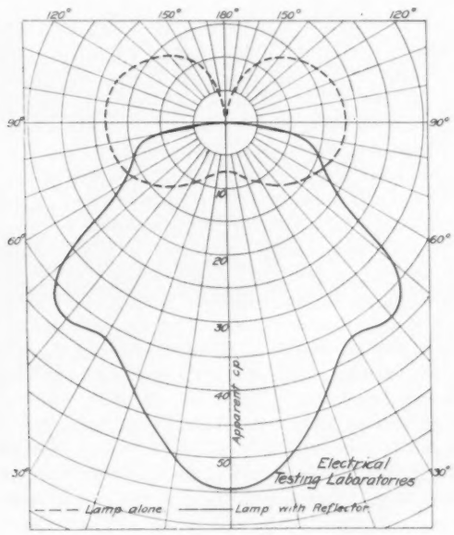


FIG. 2.—DISTRIBUTION OF LIGHT.

New Magnetic Steel.

Nearly 20 years ago the engineers of the Thomson-Houston Company, the predecessor of the General Electric Company, made the discovery that certain impurities in iron greatly improved its electrical characteristics, and that these impurities existed to much more nearly the desired amount in commercial open-hearth steel than in pure Norway iron. There are four essential qualities for iron or steel when it is to be subjected to magnetization by alternating current, namely, high permeability, low hysteresis, high specific resistance (to limited eddy currents), and permanence with reference to hysteresis.

The principal materials which appear as impurities in iron are carbon, sulphur, manganese, silicon and phosphorous, which elements exist in quantities varying from a few hundredths to 0.2 of 1 per cent. The extent to which each of these materials is found in steel affects both the mechanical and magnetic characteristics of the steel, and many of them affect one characteristic more than they affect another. It is not strange, therefore, that experimenting for the best possible steel with the above four characteristics has had to be largely a "cut and try" process and that real improvement has only been obtainable after the expenditure of much time and money.

The improvements in the steel adopted by the Thomson-Houston Company over the various grades of iron previously used were along all four essential lines mentioned above, but particularly with reference to the permanence, in that while the best Norway iron carefully annealed had losses little if any in excess of the grades of steel adopted, the improvement was not maintained, but in the course of time even the moderate temperatures to which the material was subjected in ordinary operation resulted in these losses increasing immensely. The open-hearth steel, on the other hand, not only responded to the annealing, but the low losses obtained thereby were almost entirely permanent.

The improvement of open-hearth steel over Norway iron was practically 100 per cent, or twice as good, taking everything into consideration. It was found that the commercial open-hearth steel first used could be further improved for magnetic purposes by very careful attention to composition of material and also the temperatures and length of time to which it was submitted in annealing. For many years slight, but constant, improvements were made by the General Electric Company with its electrical sheets, and a great amount of time and money was expended in investigations and in determining the best results.

Several years ago Dr. John F. Kelly, then with the Stanley Electric Manufacturing Company, found that steel having a small amount of silicon showed some improvement over ordinary open-hearth steel, and a patent covering the same was issued to him. At that time, however, difficulties at the mills in obtaining the material prevented its use.

Several years ago the General Electric Company investigated the beneficial effects of using silicon in proportions of 10 to 30 times greater than the amount of the impurities previously existing in good steel, and succeeded in overcoming the very serious problems involved in the making and rolling of such steel. This material, to an even greater extent than mild steel, disproves the theory that pure soft iron is the best possible magnetic material, first, because it is so very far from pure iron that the silicon should be classed as an alloy rather than an impurity, and, second, because even with the most thorough annealing it is never soft.

Sheet steel having silicon in proper proportions, and properly produced in the mill, not only gives far lower hysteresis loss than ever obtained before, but also gives a very large reduction of the eddy-current loss due to the fact that the alloy increases the specific resistance three to five times. In addition, it establishes the magnetic stability of the steel so that the material is practically non-aging, even when subjected to imperfect conditions in manufacture or excessive temperatures in use to an extent never approximate with other materials.

The General Electric Company, notwithstanding its greatly increased cost, put this material into use in all its transformers, so that at the present time there are practically 250,000 of these transformers now in service. Laboratory tests regarding the permanence of the material have been confirmed by tests on many transformers which had considerable service.

Electrical Equipment of Great Southern Lumber Company's Plant at Bogalusa, La.

One of the most important electrical installations of recent times is that lately completed by the Great Southern Lumber Company, at Bogalusa, La. Its importance arises not only from the fact that it is the first installation of this kind in that section

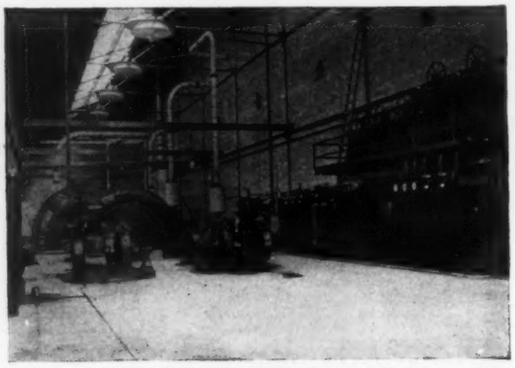


FIG. 1.—INTERIOR OF POWER HOUSE.

of the country, but because it is the largest electrically-equipped wood-working plant in the world.

The enormous capacity of this plant has made it necessary to cover a large area, consequently considerable of the wood-working machinery is located at such a distance from the main saw mill that the transmission of energy would be almost impracticable through any other means than by electricity. The distribution of power could have been accomplished by cable transmission, or the various mills could have been operated by independent steam plants, but the low efficiency of such methods of drive was objectionable in this case.

A practical millman will readily understand that there are a large number of complications required where rope transmis-

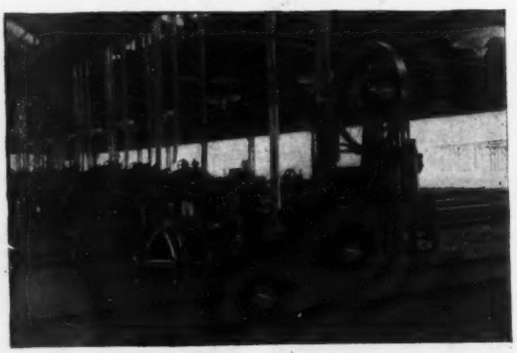


FIG. 2.—BAND RESAW DIRECT-CONNECTED TO INDUCTION MOTOR.

sion is used and that such a system only multiplies the use of belts, pulleys, hangers, etc., as well as adds to the cost of help necessary to keep such apparatus in working order.

The installation of several steam plants, including the cost for boilers, steam engines, pumps, piping, etc., may not be considered as being prohibitive in the matter of first cost, but the expense of maintenance, including insurance and the cost of labor connected with these separate steam installations, make such applications expensive and the plant a source of worry.

The electric drive when properly installed does away with long lines of shafting and multitudes of hangers, journal boxes, etc., which have to be continually looked after and kept in re-

pair. It further does away with a great number of expensive belts, which frequently break and have to be renewed or retightened owing to various conditions which must be anticipated.

It is not possible to eliminate all belting in a wood-working plant where electric motors are used, as for example, the small machines in the filing room which may be grouped so that several operate from one motor, or the lumber sorters, blowers and stackers may require short lengths of belting; but even in this case long lines of shafting and gearing may be eliminated. The

FIG. 3.—BELT-CONNECTED BLOWER.

excellent arrangement and consequent economy of operation of this plant secured by direct drive is in a great part due to the efforts of Mr. G. U. Borde, of New Orleans, who acted as consulting engineer for this company.

The entire 1500 hp for use about the mill is generated at a central point by General Electric generators and is distributed through cables to motors located at the machines to be driven. The three generators, direct driven by slow speed engines and delivering current to the line at 2300 volts, are excited by current from two direct-current marine engine sets shown in the foreground of Fig. 1. The entire energy is carried to the mill through cables in underground conduits.

The wood-working machinery furnished by the Berlin Machine Company, as well as the auxiliary apparatus and sizes of motors, is listed in the following table:

PLANING MILL NO. 1.

13 16-in. No. 238 trim saws, each direct coupled to 5-hp, 1200-r.p.m. motor.
17 No. 94 planers and matchers, each direct coupled to 35-hp, 900-r.p.m. motor.
2 No. 266 three-saw gang edgers, each belted to 35-hp, 900-r.p.m. motor.
1 64-in. No. 285 band rip saw, direct coupled to 55-hp, 514-r.p.m. motor.
1 44-in. No. 283 band rip saw, direct coupled to 25-hp, 600-r.p.m. motor.
1 44-in. No. 281 band rip saw, direct coupled to 25-hp, 600-r.p.m. motor.
1 30-in. No. 177 double surfacer, direct coupled to 35-hp, 900-r.p.m. motor.
3 double 70-in. Sturtevant blowers, each direct belted to 150-hp, 600-r.p.m. motor.
All machinery in the filing room is connected with line shafting, belted to a 10-hp, 1200-r.p.m. motor.

PLANING MILL NO. 2.

8 No. 94 planers and matchers, each direct coupled to 35-hp, 900-r.p.m. motor.
1 44-in. No. 281 band rip saw, direct coupled to 25-hp, 600-r.p.m. motor.
4 16-in. No. 238 trim saws, each coupled to 5-hp, 1200-r.p.m. motor.
1 double 70-in. Sturtevant blower, direct coupled to 150-hp, 600-r.p.m. motor.

PLANING MILL ON TIMBER DOCK.

1 30-in. by 20-in. No. 1 timber sizer, direct coupled to 85-hp, 900-r.p.m. motor.
1 No. 94 planer and matcher, direct coupled to 35-hp, 900-r.p.m. motor.
1 double 60-in. Sturtevant blower, direct coupled to 150-hp, 600-r.p.m. motor.

DRY LUMBER SORTER.

Dry lumber sorter, driven by 1 35-hp, 900-r.p.m. belted motor.

LUMBER STACKERS.

8 lumber stackers, driven by 8 25-hp, 600-r.p.m. belted motors.

FUEL CONVEYORS.

2 fuel conveyors, driven by 2 35-hp, 900-r.p.m. belted motors.

CENTRIFUGAL PUMPS.

2 14-in. centrifugal pumps for pumping into log ponds, each direct coupled to 85-hp, 720-r.p.m. motor.

MACHINE SHOP.

1 2-hp motor connected to upright drill.
1 2-hp motor connected to bolt cutter.
1 7½-hp motor connected to planer.
1 2-hp motor connected to pipe machine.
1 2-hp motor connected to pipe machine
1 3½-hp motor connected to shaper.
1 5-hp. motor connected to radial drill.
1 3½-hp motor connected to machine lathe.

RELAY BLOWER STATIONS.

2 double 70-in. Sturtevant blowers, belted to 2 150-hp, 600-r.p.m. motors.

Transformers inside the mills reduce the pressure to 440 volts, at which pressure the motors driving the various mill machines are operated. All of the machines in the three mills of this plant are driven by the induction motors which on account of their extreme simplicity and sturdiness are especially suited to this class of work. Moreover, the electric motor of such sizes as are used in this work is essentially a high-speed, high-efficiency machine, making it not only possible but highly desirable to connect this direct to the shaft of the machine to be driven. This has been done in all except a few instances, as the higher efficiency obtained with the absence of long belts and lines of overhead shafting more than justifies the extra first cost for individual motors. Swing saws, planers, matchers and

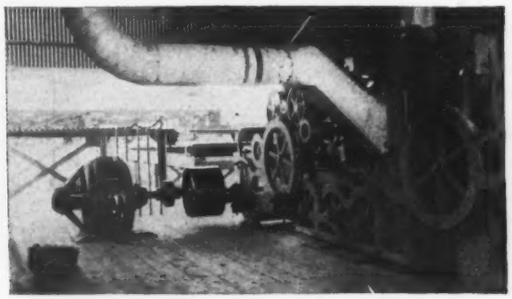


FIG. 4.—DIRECT-CONNECTED TIMBER SIZER.

band saws are all connected direct to the driving motor. This makes the lighting remarkably good as it does away with all overhead shafting and belts, and at the same time gives an installation of remarkable flexibility. The good lighting and entire absence of belts are well shown in Fig. 2, which illustrates the direct motor drive to a band rip saw.

The dust, which is generally such an obstacle to the satisfactory operation of planing mills, is removed by electricity. Seven double blowers are driven by 150 hp motors drawing the dust up through a system of pipes. These blowers are distributed through the mill as follows: One in each of the small planing mills, two in the rough lumber shed and three in the main planing mill. About 8 oz. pressure is maintained by these, which not only carries away dust and fine shavings but also knots and large chips. One of these blowers is shown in Fig. 3 and the arrangement of the pipes is well shown in Fig. 2.

Fig. 4, showing an 85-hp motor connected to a timber sizer, gives a very good idea of the simplicity and compactness of this form of drive. This sizer is in the planing mill on the timber dock as shown in the diagram.

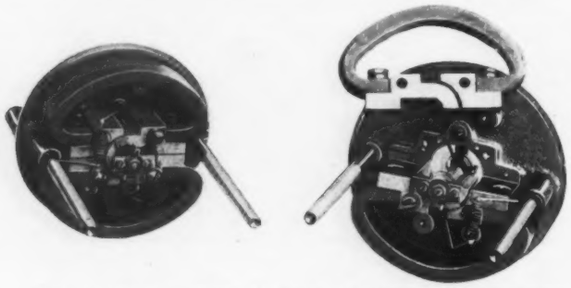
FIG. 5.—VIEW OF BAND RESAW, SHOWING MOTOR AND MOTOR STARTER.

Each of the motors is supplied with a starting device and protecting fuses at the motor, so that each machine is a plant in itself and practically independent of the other machine. Fig. 5 shows one of the starting compensators connected to a motor driving a band edger. The fuses at each machine protect that motor and its cable from internal injury, and as the cables are encased in iron conduits fire danger is eliminated.

The entire installation is one that exemplifies the best and most economical method of handling lumber; and the cleanliness and flexibility secured by the improved methods used are making the dusty sawmills of the past more and more uncommon.

New Form of Direct-Current Ammeter and Voltmeter.

Recent improvements in factory methods and in design features by the Westinghouse Electric & Manufacturing Company have rendered possible the production of a small-sized switchboard instrument of the permanent magnet type. These instruments are made as ammeters and voltmeters, and are mounted in neat black Electrose cases, 5 in. in diameter, rear connected, with circular beveled glass front-plates. The use of a case made from insulating material instead of metal gives a degree of insulation not usually found in small instruments. Owing to the peculiar self-shielding form of the permanent



FIGS. 1 AND 2.—DIRECT-CURRENT AMMETER AND VOLTMETER.

magnets, an iron case is said to be unnecessary for shielding against the effects of external fields. The meters are supported by means of brass studs projecting from the rear of the case, serving at the same time as terminals.

The voltmeters are made self-contained, including resistance, in any rating as high as 300 volts, and the ammeters are operated from external shunts, the shunts of the sizes up to and including 75 amp being mounted directly on the meter studs. The scale divisions are uniform, and the total length is almost the same as that found in the usual 7-in. diameter meters. The most interesting feature of these instruments is the "single air gap" type of construction, which differs from the original D'Arsonval bipolar magnet with two cylindrical air gaps in series. The principal advantages of the single air gap construction in permanent magnet meters were described in the Electrical World of Feb. 15, 1908.

The removability of the permanent magnets is really of the greatest importance to the user who desires to do his own repair work on the premises. Fig. 1 shows an internal view of the meter mechanism with the case removed, and Fig. 2 shows the process of removing the permanent magnets when repairs become necessary.

The principal applications for this class of instrument will be for small panels, such as for rectifier outfits, battery charging, small isolated plants, small marine plants, or even on regular large switchboard work where a small-sized instrument is desirable. The instruments are light in weight and the parts are all machine made in large quantities, with a highly organized and accurate tool equipment, the assembler merely attaching these parts together without further fitting.

Electric Instantaneous Water Heater.

The Grinnell Electric Heater Company, of Grinnell, Iowa, has just brought out an instantaneous electric water heater, which is the invention of Grinnell central-station men, the need for such a heater being brought forcibly to their attention in connection with the introduction of complete electric cooking outfits in homes where it is desirable to eliminate during the summer every heating medium but electricity. In a town where there is no gas, the greatest obstacle to the introduction of complete electric cooking outfits and the elimination of coal and gasoline stoves is that of providing hot water quickly for washing and cooking purposes. The Grinnell instantaneous electric water heater is a very simple device, consisting simply of insulated carbon electrodes placed inside of an iron pipe. The current passes through the water from one carbon electrode to the other.

This principle, of course, is not new, the chief novelty of the Grinnell heater being in the method of cementing and insulating the carbon electrodes so as to make them heatproof and waterproof and to avoid the electrolysis of the metal ter-

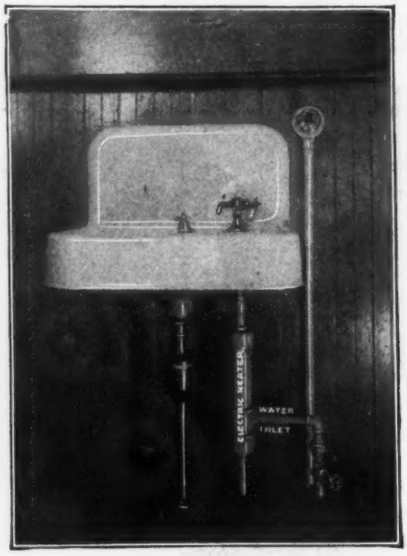


FIG. 1.—HEATER ATTACHED TO WASH BASIN.

minals. Fig. 1 shows a heater attached to a lavatory and Fig. 2 a heater attached to a bathtub. It is placed directly in the cold water inlet pipe. When cold water is wanted, no current passes through the heater. When hot water is wanted, the wall switch is turned, so that current flows through the heater. The same faucet can, therefore, be used for both hot and cold water. As there are no coils to burn out, it is claimed there is no detriment to the heater if current is incidentally left turned into the heater

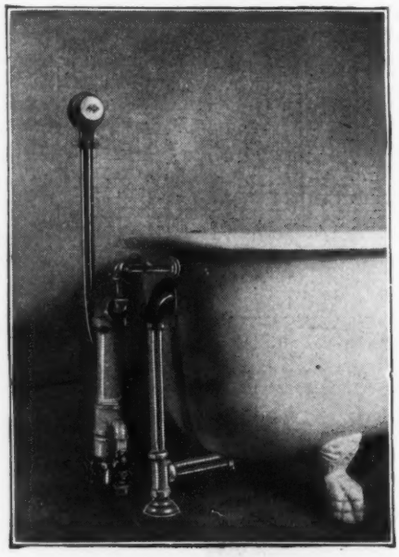


FIG. 2.—HEATER ATTACHED TO BATHTUB.

indefinitely. It will simply cause the formation of steam in the heater which will force the water out of the heater and reduce the current flowing through the heater from one electrode to the other.

Another style of heater is also manufactured in which the turning of the water faucet closes the circuit through the heater by means of a standard snap switch. These heaters are made in sizes ranging from 1000 to 6000 watts.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There seems to be a gradual expansion of future buying, especially in the larger centers of the Middle West and in the South. This resumption is conservative and has not as yet done much toward bringing trade back to normal proportions, but it it is indicative of the growth of confidence in the future. Reports regarding the growing crops continue rosy and these bright prospects, coming so near to the period of maturity, lend additional assurance that the farmers will enjoy prosperity. While no bumper crops are promised, with the possible exception of cotton, there is a slight increase over last year in winter wheat, and spring wheat promises to be above the average except in the Pacific Northwest. Owing to the excellent growing weather of the last two weeks, the yield of corn is sure to show a considerable percentage over that of last season. The oat crop will be larger than ever, although possibly not so unusual as was promised a month ago and the Western hay fields will probably yield a larger product than ever before. Fruit conditions are excellent over the entire country, and the abundance of feeding crops indicates that animal products will probably be lower during the coming fall and winter. In industrial lines, too, there is some evidence of revival, due to the general improvement in tone and more cheerful feeling in all lines of trade. The number of idle operatives is being gradually reduced, but the progress toward resumption is of a very conservative kind and there is still a marked curtailment in manufacture. In jobbing circles filling-in orders are still the rule, and few large purchases for the future are recorded. Retail trade continues to be fair, especially throughout the West, where forced sales are almost universal. Opinion is unanimous that retailers' stocks are very light. In the iron and steel industries a better feeling is apparent and numerous carshops have resumed operations. The decreases in railroad earnings are not so discouraging as a few weeks ago and the number of idle cars continues to diminish, owing in some measure to the liberal movement of wheat to market from the Southwest. Improvement in building operations is reported in many of the larger cities, and the lumber trade reports a distinct betterment. From the Pittsburg district many reports come of a return to activity in furnaces and steel mills. Almost all of the great plants of the United States Steel Corporation have called into service idle employees, and the fact that this activity is more marked among the furnaces than in the mills producing finished products, shows that the management is preparing a supply of pig iron for future activities which the signs of new prosperity promise. In many of the busy centers of this district, where actual work has not yet been resumed by the mills, great activity is displayed in overhauling machinery and making repairs, demonstrating the confidence felt that in the near future every available facility will be called into requisition. In the meantime, hopeful expressions continue to come from leaders in finance and in trade. John Claflin, of New York, proclaims full confidence in the early resumption of normal conditions. Others express themselves with the same cheerful optimism and even railroad presidents, in spite of the disconcerting figures returned in monthly reports, declare their belief that the turning point has been reached and that the improvement in traffic from this time forward will be continuous. Business failures for the week ended July 23, according to *Bradstreet's*, number 263, against 258 in the previous week, 155 in the corresponding week of 1907, 171 in 1906, 197 in 1905 and 174 in 1904.

THE COPPER MARKET.

During the week ended July 27 there was a distinct improvement in conditions in the copper market, and some slight advance in price. It is said that some large consumers, believing that the heavy production must inevitably force a decline, failed to provide for their August requirements until July 25, and then, when forced by circumstances to go into the market, were obliged to pay as high as 13⅛ for electrolytic, to be delivered in 30 days. The same situation is said to have developed in Europe, and the buying in the two countries did much to give confidence to the market. The main feature of the earlier part of the week was the liberal trading in standard warrants by the speculative element. The higher price for warrants invited larger sales by both dealers and producers against these contracts, and eventually forced an advance in prices. When, however, electrolytic was put up ¼ cent per lb., producers, both in this country and in Europe, showed more disposition to sell, and even to make slight concessions for sales to dealers and consumers. Bids at 13 cents for copper for export have been refused during the week, as producers seem to be thoroughly convinced that domestic consumers will soon be forced into the market. In spite of these conditions melters have, for the most part, remained thoroughly conservative, and have covered no further than seemed absolutely necessary. European cables indicate that the bankers there who have been financing the surplus stocks of copper abroad have become somewhat alarmed at the heavy accumulations, and are inclined to require a wider margin upon their loans. In this country large consumers of copper declare that there has been little improvement in the takings during July as compared with June, but a few manufacturing companies have been able to increase their orders for finished products by making price concessions. In the meantime the production in this country, including the smelting and refining of foreign material, is running at the rate of about 90,000,000 lb. per month, while domestic consumption is taking scarcely 30,000,000 lb. per month, leaving a surplus of 60,000,000 lb. monthly to be exported and consumed abroad. Exports during July will fall considerably under 40,000,000 lb., according to present indications, indicating an increase in domestic stocks during the current month of 20,000,000 lb., bringing the total estimated surplus here to between 125,000,000 and 135,000,000 lb., but the heavy surplus, of course, is being carried in Europe, where the monthly consumption of American copper is probably in the neighborhood of 40,000,000 lb. per month as a maximum. Exports for the week ended July 27, were 6,565 tons, and for the month of July, to this date, 16,248 tons. Closing prices on the Metal Exchange, July 27, were:

Lake	13	@ 13¼
Electrolytic	12⅞	@ 13
Castings	12⅝	@ 12¾

The London market was as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	59	2	6	59	5	0
Standard copper, futures	59	17	6	60	0	0
Market	Firm.			Firm.		
Sales of spot				600 tons		
Sales of futures				1,600 tons		

Extreme fluctuations for the year:

	Highest.			Lowest.		
Electrolytic copper, spot	13¼			12¼		
Lake copper, spot	13⅜			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	£64	5	0	£56	5	0
London, futures	64	10	0	56	17	0
London, best selected	67	10	0	60	0	0

THE PLATINUM SITUATION.

A steady decline in the price for platinum has taken place since the business depression began until at present this metal is selling for less than half of the figures quoted 18 months ago. This decline has revived the story from Russia, where 90 per cent of the world's platinum is mined, that the government had determined to impose a heavy tax and double the cost of the consumer. Such a step has been talked of before, but those who are interested in the industry in this country refuse to believe that this course will be taken at a time when the demand is the smallest for many years. One large consumer, in discussing the decline in price, expressed the opinion that prices heretofore had been unreasonably high and that the present decline was but the reaching of a justifiable commercial basis. The legitimate consumption of the metal, he said, was not beyond the ordinary production, and under such circumstances there was no reason why a fictitious price should be demanded. The use of platinum at a price of $40 an ounce, he said, was practically prohibitive in many lines of business, and even at half this figure, the present quotation, there is so little demand that the metal is practically a drug on the market. This authority thought the price would be much lower, reaching eventually a level where the consumer could figure upon its use with safety. On the other hand one of the largest dealers

in crude and refined platinum in America stated that, in his opinion, materially lower prices were improbable. "At the present time," he said, "I believe that it would be possible to go into this market and buy 25, or possibly 50, ounces of refined platinum at $18.50 or $18.75 per ounce. I do not believe 200 oz. could be bought for less than $19.50, if even that low, and I am sure that if anyone wanted 1000 oz. or more he would be unable to get it at $20. In other words, there may be a few little lots made up of odds and ends and scrap, held by small dealers who would make a concession in order to close a sale, but no prudent business man would contract to deliver 1000 oz. unless he knew where he could get the metal; and I do not believe it could be had either in this country or in Europe at the figures quoted. The fact of the matter is that platinum is closely held by very strong dealers. The Russians, who control the market, are hard people to move. When there is little demand they talk of price concessions, but the reductions are not conceded willingly, and just as soon as these dealers find that someone wants to buy they advance the figure. As I happen to know, a large portion of the platinum mined last year is held by foreign banks. The demand from consumers was light and the producers needed money so that the bankers made advances. These advances in most cases, according to my European information, were made on a basis of from $22 per ounce upward. Now these bankers can afford to wait and this metal will not be sold at a loss. The banks must have principal and interest. Under these circumstances, I expect to see the metal sell higher before it goes lower. What will be the course of the market in some future year no one can foretell, but at the present time, in my opinion, platinum is too strongly held to let any decline in price take place."

THE ELECTRIC MEAT CURING COMPANY will establish a plant at West Sixty-fifth Street, near the Union Stock Yards, in Cleveland. This company owns a system of curing meats with the aid of electrical energy, and an apparatus has been devised for that purpose. The old method of soaking the meat in brine has not been changed, but with the aid of this apparatus it is claimed that the salt will penetrate the meat in two or three days, whereas it has heretofore required about 20 days. It also does away with the work of handling the meat, to a great extent, and insures sanitary conditions in the plant. It is said that the system and apparatus have been thoroughly tested in one of the packing plants in Cincinnati and that the owners of the plant are enthusiastic in their recommendation of the results. The company will establish a plant in Cleveland, but the plan is to lease the apparatus to packers on a basis that will insure a satisfactory return on the investment. The promotors claim that this system will be of great advantage in the process of curing, especially in the case of preparing bacon. The company, incorporated with a capital stock of $1,000,000, has its general offices at 526 Society for Savings Building, Cleveland, and the officers are as follows: F. B. Wagner, president; John Theurer, vice-president; B. B. Quinn, secretary, and J. J. Mauldin, treasurer. John C. Lincoln is the chief engineer, and with the other names above constitute the board of directors.

NEW GENERAL ELECTRIC ORDERS.—The General Electric Company announces that the following orders for new apparatus have been recently received: Isthmian Canal Commission—Six vertical Curtis turbine units, 1500-kw, 25-cycle, 2200-volt each complete with individual base condenser, air and circulating pumps and necessary piping; electrical equipment for one 20-ton traveling crane; four 35-kw, 125-volt, direct-current turbine-driven exciters; four 500-kw, 600-volt rotary converters, each complete with three air-blast-type transformers; six 100-kw, 2200-6600-volt, single-phase, oil-cooled transformers; six 100-kw air-blast-type transformers; two switchboard equipments. Mitsui & Company, Japan—Fifty GE-52 railway motor equipments, also rotary converters, transformers, etc.; 20 GE-52 double-motor equipments, with headlights and spare parts; three 1000-kw alternating-current generators. Australian General Electric Company—Seventy four-motor type M control equipments for railway motors. Santos Dock Company, Brazil—Six 3300-kw transformers and five 50-light constant-current transformers; one motor-generator set; 628 arc lamps; one switchboard; miscellaneous small motors and transformers. Pueblo Tramway, Light & Power Company, Mexico—Ten water-cooled, 1500-kw, 60-cycle transformers.

IMPROVEMENTS OF TAMPA ELECTRIC COMPANY.—The Tampa Electric Company, of Tampa, Fla., has contracted with the Stone & Webster Engineering Corporation for enlargement of its main power station on West Jackson Street, Tampa, Fla., and numerous improvements in the electric service of the city. The station will be enlarged sufficiently to house two turbine units with all necessary steam and electrical auxiliaries in addition to the present equipment. One turbo-generator equipment of 1500-kw rating, arranged to generate current at 2300 volts, with a 520-hp water-tube boiler, will be immediately installed. The present overhead lighting circuits of the company carry 133-cycle current. These circuits will be reconstructed for 60-cycle current and extended, and the present meters will be readjusted or replaced by three-wire lighting and two-phase power meters. The present 133-cycle overhead power circuits will be rebuilt to carry 60-cycle, two-phase current with corresponding changes in service connections, building, wiring and in meters. The work planned will cost in excess of a quarter of a million dollars.

CONNECTICUT RIVER POWER COMPANY.—The Connecticut River Power Company, through its engineers, J. G. White & Company, Inc., of New York City, has placed an order with the General Electric Company for the following electrical apparatus: Five 3000-kw vertical-shaft waterwheel-driven generators; two 300-kw vertical-shaft waterwheel-driven exciters; three 5000-kw, three-phase, water-cooled transformers; one 1000-kw, three-phase, water-cooled transformer and one complete switchboard for controlling the apparatus, which is all to be installed at the company's plant on the Connecticut River near Brattleboro, Vt. The river work has progressed so far that the dam is nearly completed, and it is expected that work on the power house will be started at an early date. Rights of way for transmission lines to Brattleboro, Vt., and Fitchburg, Mass., have been secured, and contracts have been let for the steel towers. Work on clearing rights of way and the erection of towers has been commenced.

AJUCHITLAN MINING PLANT.—The Ajuchitlán Mining & Milling Company, in the State of Queretaro, whose property is located near Bernal Station, on the National Railroad, are now installing a number of electric motors, with all necessary appliances, providing for a very complete electrical installation. This property is under the management of Mr. C. Crowell, mining engineer, of Monterey. This company will take power from the Cia. Hidro-Electrica Queretana, of Queretaro, the transmission line to the mine being some 25 km. A 100-hp motor will be used to drive the Kent mill and also the crushers. The ore is of a very hard nature, being similar to that found in the El Oro district. The smaller motors will be used in connection with pumps and other parts of the works, arranged for both belt and direct-connected service. All of the electrical apparatus was purchased from Messrs. G. & O. Braniff & Company, who provided Westinghouse apparatus for the entire installation.

MILLION-DOLLAR UNDERGROUND CONTRACT.—The contract has been let by the Portland Railway, Light & Power Company for the building and equipping of a complete underground system of conduits and cables in the city of Portland, Ore. The contract amounts to over $1,000,000 and was awarded to the engineering firm of W. S. Barstow & Company, of New York and Portland. Estimates and plans are now being prepared and the work will be started within a short time. All systems will be included in the work, not only the railway feeders and lighting system, but also all transmission and power lines. For the business district it is probable that the standard three-wire, 220-volt, direct-current system will be adopted, and the present 60-cycle, three-phase, alternating-current system used for the outlying districts.

Financial Intelligence.

THE WEEK IN WALL STREET.

Undoubtedly the most striking feature affecting the Wall Street market during the week ending July 27 was the decision of the United States Circuit Court of Appeals, in Chicago, setting aside the $29,000,000 fine imposed on the Standard Oil Company. This decision had been discounted in a measure by insiders, for the radical upward turn began before the action of the court was announced. The most important influence that it wielded was in improving the feeling of confidence on the part of the public. The important feature of the decision is the feeling created by the court ruling that corporate property cannot be confiscated either as a result of an overzealous prosecution or to satisfy a popular hue and cry. The enunciation of such principles of justice lends confidence to every

investor in securities. With the courts ready to protect corporations from the unreasoning attacks of politicians, men with money to invest need not be timid. To this extent the decision last week braced up the tone of the Wall Street market. But there were other conditions which helped the actual improvement in prices and brought buyers into the market. The continued good reports from sections of the West where the maturing crops are bearing out the earlier promises of liberal yields, gave assurances of new prosperity. Conditions of general trade were materially better in tone, and few commercial lines are to be found in which pessimists are prominent. Following a meeting of the heads of the subsidiary companies of the Steel Corporation, President Corey announced that reports from all directions were encouraging, and that orders were constantly increasing. Among the New England mills many resumptions were reported, and railroad officials could see that there was some betterment in traffic, and that fewer cars were idle. All of these things induce outsiders to visit the Wall Street bargain counters, and the very natural result was that transactions mounted to almost the "million share" mark, and prices reached higher levels than at any time since the depression began last October. Another fact that has helped is that within a fortnight Europe has bought more than $30,000,000 of American securities. This was beneficial not only because it buoyed the market, but because it established undeniably the fact that foreign confidence in our business enterprises has been restored. The fact that the market reacted during the last three days of the week under review, and that the volume of trade was reduced, caused no discouragement to those who believe that the revival has really set in. What is hoped for is a conservative and gradual advance of dividend paying securities to a point where the returns will not be so widely at variance with the actual value of money in the lending market. The gradual upbuilding of prices as business conditions return to the normal is much more to be desired than any advance brought about through a speculative bull movement. In spite of the reaction and the dull sagging market July 27, the net changes for the week were almost entirely advances, and in some instances substantial gains were made. The most marked of these was in Westinghouse Electric & Manufacturing common, which recorded a sensational rise of 30 points in three days, and closed the week with a net gain of 12¾. Illinois Central and Railway Steel Spring, were among those which made the most substantial gains. The tremendous trading in Reading and in Steel common continued, although the latter closed the week at about the same figure as for the week previous. Money continued easy, although the demand was slightly more active, and the call from the West for crop moving purposes was already beginning to be heard. The quotations are those of the close of July 27:

NEW YORK.

	July 20.	July 27.	Shares Sold.		July 20.	July 27.	Shares Sold.
All.-Ch.	11⅛	11	3,910	Int.-Met., com.	11½	11⅛	4,990
All.-Ch., pfd.	34½	33¼	5,300	Int.-Met., pfd.	31½	31¼	12,200
Amal. Cop.	71⅝	73½	216,900	Mackay Cos.	65¾	59	400
Am. D. T.	39*	39*	———	Mackay Cos., pfd	68	68¾	1,500
Am. Loc.	52¾	54	34,735	Met. St. Ry.	25*	30	100
Am. Loc., pfd.	105½	105	950	N. Y. & N. J. Tel.	108*	112	300
Am. Tel & Cbl.	64½*	64½*	33,800	Steel, com.	45⅛	44⅜	596,613
Am. T. & T.	118	121¾	71,800	Steel, pfd.	108⅞	108¼	31,757
B. R. T.	51½	52	———	W. U. T.	56	56*	1,880
Gen. Elec.	144¾	145¾	14,836	West'h, com.	64¼	77	59,819
Hud. R. Tel.	—	—	———	West'h, pfd.	92	95½	1,600

PHILADELPHIA.

	July 20.	July 27.	Shares Sold.		July 20.	July 27.	Shares Sold.
Am. Rys.	44¼	44	———	Phila. Elec.	9¼	9⅝	———
Elec. Co. of A.	10⅛	10⅛	———	Phila. R. T.	14	15½	———
Elec. Stor. B'ty.	33	35½	———	Phila. Traction.	89¼	90½	———
E. S. B'ty, pfd.	49*	49*	———				

CHICAGO.

	July 20.	July 27.	Shares Sold		July 20.	July 27.	Shares Sold.
Chi. City Ry.	178	176½	———	Met. El., com.	15	15*	———
Com. Edison.	103	103	———	Met El., pfd.	50*	48½	———
Chi. Subway.	20¼	21	———	Nat'nal Carbon.	69½	70	———
Chi. Tel. Co.	140	140	———	Nat. Carb., pfd.	111½	111	———

BOSTON.

	July 20.	July 27.	Shares Sold		July 20.	July 27.	Shares Sold.
Am. Tel & Tel.	118	122	———	Mass. E. R., pfd.	48	47	———
Comb'ind Tel.	109½*	109½*	———	Mex. Tel., pfd.	—	—	———
Edison El. Ill.	215	216¾	———	N. E. Tel'p.	113	114	———
Gen. Elec.	144¼	145	———	W. Tel. & Tel.	—	6*	———
Mass. Elec. Ry.	10	10	———	W. T. & T., pfd.	63½	68	———

*Last price quoted.
Shares sold are for week July 20 to July 25.

DIVIDENDS.

New England Telephone Company, quarterly 1½ per cent, payable Aug. 15.

Pressed Steel Car Company, preferred, quarterly 1¾ per cent, payable Aug. 26.

Lawrence (Mass.) Gas Company, semi-annual, 4 per cent, payable Aug. 1.

Philadelphia Company, Pittsburg, preferred, semi-annual, 2½ per cent, payable Sept. 1.

Connecticut Railway & Lighting Company, Bridgeport, Conn., preferred and common, quarterly, 1 per cent, payable Aug. 15.

Montreal Light, Heat & Power Company, quarterly, 1½ per cent, payable Aug. 15.

Boston Elevated Railway Company, quarterly, 3 per cent, payable Aug. 15.

BIG RISE IN WESTINGHOUSE STOCK.—Among the sensational features of the Wall Street market during the activity which characterized the trading July 21, 22 and 23, were the violent price changes in the Westinghouse Electric & Manufacturing Company's common stock. From comparative inactivity, at prices ranging along between 55 and 60, the stock became the center of a buying movement and quotations went upward. Thousands of shares were traded in, where a few days before deals of 100 share lots were scarce. In two days the stock advanced 30 points, touching 89¼ on July 22; it then lost half of the gain almost as quickly as the stock had risen. Since July 1 but little active canvassing for additional subscriptions to the assenting stock has taken place, and the total amount of subscriptions have been but little augmented. Speaking of the stock activity, a member of the reorganization committee said: "The condition of the reorganization work is practically the same as it was a month ago. About 95 per cent of the merchandise creditors have agreed to accept settlement of their claims in the new stock at par, but the subscriptions from the stockholders have not come in as rapidly as desired. There is yet a considerable amount of this allotment to be subscribed, and some of the largest shareholders have not come in at all. Of course, the success of the plan depends on the stockholders taking the $6,000,000 proposed in the original scheme, but if they do not do this by Sept. 1, the whole plan is a failure." The main difficulty with which the reorganizers have had to contend from the start has been the publicly quoted price of the stock. It is somewhat difficult to secure subscriptions at par to a stock that can be bought in the market between 50 and 60. The reorganization committee has announced its belief that if the plan is successfully carried out the company will be able to place its common stock on a 6 per cent basis when business resumes its normal conditions. In the meantime reports as to the company's business are encouraging.

NEW YORK GAS, ELECTRIC LIGHT, HEAT & POWER BONDS COMMENDED.—Referring to the Purchase Money 4 per cent gold bonds issued by the New York Gas, Electric Light, Heat & Power Company, now controlled by the New York Edison Company, Spencer Trask & Company have just issued a circular recommending the securities for investment. The bankers say: "We are officially advised that at the time of the consolidation (1898) of the Edison Electric Illuminating Company, of New York, with the New York Gas & Electric Light, Heat & Power Company, the properties of the former company were worth several times the amount of the $6,500,000 underlying 5 per cent bonds, and that since that time there has been expended upon the properties of the Edison Electric Illuminating Company, of New York, about $7,500,000 cash. In addition, we are officially advised that large expenditures out of earnings have been made upon the properties of the former Edison Electric Illuminating Company, of New York, as well as upon the other properties of the New York Edison Company. Including the purchase money 4 per cent bonds, the total amount of bonds issued against the entire electric lighting business of the Island of Manhattan amounts to less than $44,000,000. Based upon population and the extent and value of the territory served, it is believed that this bonded debt will compare favorably with that of any other electric lighting corporation in this country."

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—The report of the American Telephone & Telegraph Company for the first six months of 1908 shows gross income to be $13,788,391, an increase over the same period of 1907 of $2,219,619. The net earnings are $12,714,621, an increase of $2,178,418, and the surplus available for dividends after paying interest and charges is $8,842,945, an increase of $1,746,534. The net surplus after paying the April and July dividends is $2,722,853. The increase in the earnings for the six months over the same period in 1907 was 20.6 per cent.

CONSOLIDATION AT SPRINGFIELD, OHIO.—Negotiations are now under way for the consolidation of the People's Light, Heat & Power Company and the Home Heating & Lighting Company, both of Springfield, Ohio, the consummation of the deal depending upon the action of a majority of the stockholders of the former. A meeting was held in Columbus last week when the stockholders discussed two propositions. One of them was made by Henry L. Doherty & Company, of New York, but this was not given favorable consideration. The other was presented by W. H. Sharp, as the representative of the directors of the People's Light, Heat & Power Company. It is said that an option has been secured on the property of the Home company for $450,000, and the plan proposed is to purchase the properties of the People's company for $450,000, issue bonds to the amount of $500,000 and common stock amounting to $1,000,000 and form a new company. The stockholders are to turn in their old stock for the new, a share of the old preferred and $50 being required for two shares of the new stock, and 30 shares of the old common for one share of the new. It is thought that the sale of new stock will clear up the floating debt of $180,000 and the present bond issue, amounting to $96,000. The new bonds, it is said, have been underwritten at 90 to pay for the properties when they are taken over. The People's Light, Heat & Power Company was organized in 1905, with a common stock of $1,500,000 and $500,000 of preferred. Dividends were paid until two years ago, when they were suspended and the money was used for other purposes. The Home Heating & Lighting Company has been a lively competitor, however, with the result that both companies have had a hard fight. A merger would settle this and put the new company in a much better position than either of the others have ever occupied. John L. Zimmerman, of Springfield, is the president of the People's Light, Heat & Power Company.

DENVER CITY TRAMWAY COMPANY.—A meeting of the stockholders of the Denver (Col.) City Tramway Company has been called for Aug. 27, to authorize an issue of $25,000,000 5 per cent 30-year mortgage bonds. The purpose of the issue is set forth in the call as follows: "To refund the present outstanding indebtedness; to acquire all or any part of the property and assets of the Denver & Northwestern Railway Company and the Denver Tramway Power Company, and to pay off or exchange for the outstanding bonds of these two companies, as well as to provide funds for future extensions, additions and improvements to the company's lines."

POWER AND RAILWAY CONSOLIDATION IN NORTH CAROLINA.—The Electric Bond & Share Company, 62 Cedar Street, New York, announces that on Aug. 1 it will consolidate under the name of the Carolina Light & Power Company the following corporations: Raleigh Electric Company, including the local railway system in Raleigh, N. C.; Central Carolina Power Company, Fayetteville, N. C.; Consumers' Light & Power Company, Sanford, N. C.

GROWTH AT PLYMOUTH, MASS.—The Plymouth (Mass.) Electric Light Company held its annual meeting July 14, and elected A. C. Bent, president, again; E. P. Rowell, treasurer; A. Lord, clerk. These are directors with W. L. Boyden and S. Harlow. Mr. Rowell is manager. The treasurer's report showed an increase in gross receipts for the year of 10 per cent. A quarterly dividend was declared of 1 per cent, payable Aug. 1.

REPORTS OF EARNINGS.	Gross. earnings.	Operating expenses.	Net earnings.	Charges.	Surplus.
Abington & Rockland (Mass.) Electric Light & Power Company, May, 1908	$3,726	$2,627	$1,099	$354	$745
Abington & Rockland (Mass.) Electric Light & Power Company, May, 1907	3,753	2,686	1,067	383	684
Brockton & Plymouth (Mass.) Street Railway Company, May, 1908	10,643	8,218	2,424	2,342	81
Brockton & Plymouth (Mass.) Street Railway Company, May, 1907	9,771	6,422	3,349	2,253	1,096
Cape Breton Electric Company (Sydney, N. S.), May, 1908	21,171	12,153	9,018	4,033	4,985
Cape Breton Electric Company (Sydney, N. S.), May, 1907	20,154	12,583	7,571	3,906	3,664
Dallas (Tex.) Electric Corporation, May, 1908	90,459	64,063	26,396	26,636	*209
Dallas (Tex.) Electric Corporation, May, 1907	89,532	62,390	27,142	22,281	4,860
Edison Electric Illuminating Company, Brockton, Mass, May, 1908	15,185	9,363	5,822	2,506	3,316
Edison Electric Illuminating Company, Brockton, Mass, May, 1907	13,739	7,924	5,815	1,142	4,672
El Paso (Tex.) Electric Company, May, 1908	42,633	28,479	14,154	7,247	6,906
El Paso (Tex) Electric Company, May, 1907	40,536	30,564	9,971	5,737	4,234
Fall River (Mass.) Gas Works Company, May, 1908	31,167	18,827	12,340	2,332	10,007
Fall River (Mass.) Gas Works Company, May, 1907	28,695	16,567	12,127	2,114	10,013
Galveston-Houston (Tex.) Electric Company, May, 1908	91,023	54,700	36,322	17,131	19,191
Galveston-Houston (Tex.) Electric Company, May, 1907	85,604	54,427	31,177	15,885	15,291
Houghton (Mich.) County Electric Light Company, May, 1908	16,078	9,986	6,091	3,237	2,601
Houghton (Mich.) County Electric Light Company, May, 1907	17,516	10,499	7,016	2,737	4,279
Jacksonville (Fla.) Electric Company, May, 1908	37,668	23,825	13,843	8,861	4,981
Jacksonville (Fla.) Electric Company, May, 1907	32,383	19,259	13,124	5,951	7,173
Lowell (Mass.) Electric Light Corporation, May, 1908	26,564	16,364	10,199	4,234	5,965
Lowell (Mass.) Electric Light Corporation, May, 1907	24,913	14,880	10,033	3,082	6,951
Minneapolis General Electric Company, May, 1908	73,677	36,662	37,015	31,221	5,793
Minneapolis General Electric Company, May, 1907	70,420	31,710	38,710	24,773	13,936
Pensacola (Fla.) Electric Company, May, 1908	15,084	12,072	3,011	4,327	*1,316
Pensacola (Fla.) Electric Company, May, 1907	19,232	11,332	7,899	3,644	4,255
Puget Sound Electric Railway Company, Tacoma, Wash., May, 1908	154,204	92,165	62,039	39,048	22,991
Puget Sound Electric Railway Company, Tacoma, Wash., May, 1907	148,273	84,320	63,952	32,608	31,344
Savannah (Ga.) Electric Company, May, 1908	48,097	30,243	17,853	15,336	2,517
Savannah (Ga.) Electric Company, May, 1907	48,331	32,630	15,701	13,986	1,715
Seattle (Wash.) Electric Company, May, 1908	386,961	216,857	170,103	80,087	90,016
Seattle (Wash.) Electric Company, May, 1907	339,616	199,103	140,512	70,121	7,279
Tampa (Fla.) Electric Company, May, 1908	45,405	32,254	13,150	2,303	10,847
Tampa (Fla.) Electric Company, May, 1907	43,612	33,058	10,554	1,348	9,205
Whatcom County Railway & Light Company (Bellingham, Wash.), May, 1908	28,957	17,696	11,261	8,002	3,258
Whatcom County Railway & Light Company (Bellingham, Wash.), May, 1907	28,003	16,306	11,697	7,372	4,324
Kings County (N.Y.) Electric Light & Power Company, Jan. 1, to June 30, 1908	1,776,722	824,660	952,062	303,280	453,784
Kings County (N.Y.) Electric Light & Power Company, Jan. 1, to June 30, 1907	1,672,835	846,077	826,758	303,280	408,966
Toledo (Ohio) Railways & Light Company, June, 1908	201,766	107,458	94,308	71,762	22,554
Toledo (Ohio) Railways & Light Company, June, 1907	212,098	123,867	88,231	66,227	22,878
Montreal Street Railway Company, June, 1908	331,212	166,084	165,128	65,088	100,040
Montreal Street Railway Company, June, 1907	325,252	175,031	150,221	55,785	94,436
Norfolk & Portsmouth (Va.) Traction Company, June, 1908	164,526	98,622	65,904	.....	.....
Norfolk & Portsmouth (Va.) Traction Company, June, 1907	254,248	149,235	105,013	.....	.....
Northern Texas Electric Company, Fort Worth, Tex., May, 1908	83,807	54,856	28,951	16,553	12,398
Northern Texas Electric Company, Fort Worth, Tex., May, 1907	84,607	49,066	35,541	12,901	22,640

*Deficit.

GENERAL NEWS

Construction News.

ALBERTVILLE, ALA.—The Commercial Club is interested in a project to establish an electric light plant and water works system. Dr. J. R. Thomas is president of the club.

WILLIAMS, ARIZ.—A special meeting of the stockholders of the Grand Canyon Light & Power Company has been called for Aug. 1 to vote on the proposition of increasing the capital stock from $50,000 to $200,000, and bonding the property for $130,000 for the purpose of purchasing the city water works and telephone plant, and installing a sewerage system and gas heating plant. The company has applied for a franchise, which will be voted upon Aug. 3. P. A. Melick is president.

ATKINS, ARK.—W. F. Atkins, who was recently granted a franchise to operate an electric light plant in Atkins, is planning to organize a company to install an electric light plant at a cost of about $5,000.

OZARK, ARK.—The Altus Gin Manufacturing & Improvement Company contemplates installing a three-phase, 60-cycle generator in its plant and also the construction of an ice plant. A. Bengler, of Altus, is president.

PRESCOTT, ARK.—The town is contemplating the purchase of additional boilers for the municipal electric light plant. E. E. Davis is superintendent.

BURLINGAME, CAL.—Baldwin & Howell have awarded the last contract for the Hayward Park Division 111, San Mateo, to the United States Gas & Electric Company, which provides for the installation of a complete electric lighting system, the laying of gas and water mains, etc.

COLTON, CAL.—Plans are being considered to increase the primary voltage of the municipal electric light plant from 1150 to 2300 volts. E. M. Crilly is manager.

GRIDLEY, CAL.—The Gridley Electric Light & Power Company will install a series incandescent street lighting system, the equipment for which has been purchased. Robert F. Beebe is manager.

GRIDLEY, CAL.—The citizens on July 13 voted to issue $33,000 in bonds for a waterworks system and to extend the municipal electric lighting system.

LODI, CAL.—The City Trustees have been enjoined from selling the $76,000 in bonds issued for the municipal electric light and water works plant. The Trustees are to appear before the superior court Aug. 5 to show cause why they should not be permanently enjoined.

SANTA CLARA, CAL.—J. S. Bogart has been granted permission to erect a telephone line along the Santa Clara-Alviso road from Santa Clara to the Omar Oaks Ranch.

SANTA MONICA, CAL.—The wharf committee of the City Council has recommended that a franchise be granted to George M. Todt for his wave motor proposition.

WILLOW, CAL.—The Glenn County Telephone Company has applied for a franchise to install a telephone system in this city. H. J. Barceloux is president.

VALLEJO, CAL.—The Board of Supervisors has ordered the plant of the Selby Smelting Company at Vallejo Junction closed until the Cotterell electrical apparatus is installed. The company is installing an electrical device invented by Professor Cotterell, of the University of California, by which it is claimed that the poison is eliminated from the ore being refined.

COLORADO SPRINGS, COL.—At the annual meeting of the Empire Water & Power Company plans outlined by the directors for extensive improvements were authorized by the stockholders, which include issuing a mortgage for $1,000,000 on its property, half of which will be taken up in the near future. The company plans to ultimately establish power plants at Manitou, Cascade and Green Mountain Falls, and to generate electricity from water on the north slope of Pike's Peak. President G. A. Taft states that operations will not await the outcome of the suit filed in the Pueblo Federal court to restrain the company from carrying out its plan.

GREELEY, COL.—Plans are being considered by the Home Electric Light & Power Company for the installation of a 300-hp gas producer, a 150-hp gas engine and a 125-kw generator in its plant. A. L. Lindner is manager.

LA JUNTA, COL.—The La Junta Electric Company contemplates discarding its direct-current machines and changing the entire system to alternating current. S. E. Sandeson is manager.

LONGMONT, COL.—The citizens have voted to authorize the City Council to make investigations pertaining to establishing a municipal electric lighting plant.

PALISADES, COL.—The Palisades Light, Heat & Power Company contemplates rebuilding its distributing system. H. L. Davis is manager.

YUBA CITY, CAL.—The Great Western Power Company has been granted a franchise to erect its wires over the streets and highways in Sutter County, for which the company paid $200.

HARTFORD, CONN.—The Tri-City Railway & Light Company, whose corporate headquarters are in this city, has filed a certificate showing an increase of 2150 additional shares of capital stock, having a total par value of $215,000. The company operates public utility plants in Iowa cities.

LITCHFIELD, CONN.—The Litchfield Electric Light & Power Company will extend its 2300-volt transmission line to Torrington, Conn., a distance of six miles. C. H. Coit is president and manager.

WASHINGTON, D. C.—Bids will be received until Aug. 4 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the navy yards and naval stations the following supplies: Mare Island, Cal., Schedule 79, induction motor; also until Aug. 11, to furnish at the navy yard, Mare Island, Cal., Schedule 94, steel enameled conduit; Schedule 95, 120,000 lb. ingot copper, etc. E. B. Rogers is paymaster-general, U. S. N.

WASHINGTON, D. C.—Proposals will be received at the Treasury Department until Aug. 4 for supplying, delivered in standard-package quantities, to various public buildings in the United States, as designated, as the requirements of the same may demand, during the fiscal year ending June 30, 1909, certain incandescent lamps. Specifications and blank forms of proposal will be supplied upon application to the Treasury Department. Beekman Winthrop is acting secretary of the Treasury.

WASHINGTON, D. C.—Contracts have been awarded by the Secretary of the Interior for electrical apparatus for the power plant in connection with the Minidoka irrigation project, Idaho, as follows: To the General Electric Company, of Schenectady, N. Y., approximately $7,660; S. Morgan Smith Company, of York, Pa., about $11,500; the Westinghouse Electrical & Manufacturing Company, of Pittsburg, Pa., $115,000, and the Allis-Chalmers Company, of Milwaukee, Wis., two contracts amounting to about $101,517 and $39,710, respectively.

STARKE, FLA.—The citizens have voted to issue $12,000 in bonds to enlarge and improve the municipal electric light plant.

TAMPA, FLA.—The Tampa Electric Company has placed a contract with the Stone & Webster Engineering Corporation, of Boston, Mass., for enlarging its main power house on West Jackson Street, Tampa, and for improvements to the lighting and power service in the city. The power station will be enlarged to provide for two additional turbine units with all necessary steam and electrical auxiliaries. One 1500-kw, 2300-volt turbo-generator set with a 520-hp water-tube boiler will be installed immediately. The over-head lighting and power circuits will be changed from 133 cycles to 60 cycles and extended, and the present meters will be readjusted or replaced by three-wire lighting and two-phase power meters. The cost of the work is estimated at $250,000.

WEST PALM BEACH, FLA.—The Ariston Ice & Electric Company, successor to the East Coast Electric Light, Power & Ice Company, contemplates enlarging its plant and will install a 206-hp engine, a 150-kw generator and a 250-hp Babcock & Wilcox boiler. W. F. Heckert is manager.

ALBANY, GA.—The Albany Power & Manufacturing Company contemplates the construction of a 40-mile transmission line to be operated at a potential of 46,000 volts. The plant will have an output of 1500 kw and will furnish electrical energy in Albany, Tilton, Poulan and Sylvester. Joseph S. Davis is vice-president and secretary.

ATHENS, GA.—An appropriation of $15,000 has been made for heating and lighting the buildings of the University of Georgia. David C. Barrow is chancellor.

CALHOUN, GA.—The Echota Cotton Mills is erecting a mill building for 10,000 spindles and 300 looms, and will install a steam power plant of from 500 to 600 hp, electric lighting equipment, etc. T. W. Harbin, of Calhoun, is president.

MACON, GA.—The City Council is considering the question of establishing municipal electric light and water plants. Preliminary steps have been taken for the purchase of the water and light plants in 1910.

SWAINSBORO, GA.—The electric lighting plant owned by Jesse Thompson has been offered for sale by the owner on Aug. 4, and unless the town purchases the plant, the same may be closed.

REXBURG, IDAHO.—It is reported that the Rexburg Light & Power Company and the Anthony Power Company have been consolidated.

ALTAMONT, ILL.—The managers of the municipal electric light plant are contemplating discarding the direct series system and installing an alternating-current street lighting system. E. H. Cavanaugh is manager.

AURORA, ILL.—It is reported that the Western United Gas & Electric Company has submitted a proposition to the City Council offering to pay the city $75,000 for a 50-year franchise, confirming all the company's rights in existing franchises. The matter will be taken up at a special meeting of the Council.

BATH, ILL.—Plans are being made to extend the main transmission line of the municipal electric plant a distance of one-half mile. J. F. Camp is manager.

CAIRO, ILL.—The Cairo Electric & Traction Company contemplates rebuilding its plant. H. W. Tolle is manager.

CHICAGO, ILL.—The Lincoln Park electric light plant will be operated by electrical energy furnished by the Sanitary District of Chicago. The type of lamp and apparatus has not been decided upon. M. H. West is secretary and manager.

CHICAGO, ILL.—Arrangements have been made between the city and the Sanitary District of Chicago whereby the latter will be permitted to erect its wires and lay conduits through the streets and alleys of the city on the same terms accorded the Commonwealth Edison and other electric light companies.

FULTON, ILL.—The Fulton Electric Light & Power Company is installing meters and will discard the flat rate system. D. Gallagher is secretary and manager.

GALENA, ILL.—The municipal electric light plant and system has been purchased by A. O. Foy, of Madison, Wis., who will take possession Sept. 1. The new owner will also furnish electricity for commercial lighting and motors.

GRANVILLE, ILL.—Sidney Whitaker, owner of the local electric light plant, contemplates extending the transmission lines to Standard and Mark to furnish electricity for lighting both towns.

GRAYSLAKE, ILL.—F. C. Wilbur Lumber Company, owner of the local electric light plant, contemplates installing alternating-current machines and extending its transmission lines to Druce Lake and Gages Lake, a distance of about six miles. F. C. Wilbur is secretary.

MEDORA, ILL.—A small gas or gasoline unit will be installed in the Medora electric light plant in the near future to provide for day service. Frank Watson is owner and manager.

OREGON, ILL.—The Oregon Electric Light & Power Company contemplates the installation of a 300-kw revolving-field alternating-current generator in its plant. F. G. Jones is president and manager.

RAYMOND, ILL.—The Hillsboro Light & Power Company will extend its transmission lines to Harvel and Irving, Ill., to furnish electricity to light the towns. J. J. Frey is secretary and manager.

ROBINSON, ILL.—W. H. Clinton, of Paris, trustee of the Robinson Water & Light Company, has applied for permission to rebuild the plant to provide for the increased demands made upon it. The cost of the work is estimated at $21,000.

SPRINGFIELD, ILL.—The City Council has passed an ordinance giving the Springfield Consolidated Railway Company a 20-year franchise. The company is to pay the city 2 per cent of gross receipts for the first 10 years and for the second 10 years 4 per cent.

TOLONO, ILL.—Work will soon commence by the Home Telephone Company on the construction of its system in this city. The company is also making arrangements to construct a telephone line from Pesotum to Champaign.

ALEXANDRIA, IND.—The Continuous Water-Power Machine Company will build and equip a factory costing upward of $60,000, which will be equipped to be operated by electricity.

CROWN POINT, IND.—The Crown Point Electric Company is installing an additional generator, of 150 kw, and an engine of 250 hp, in its plant. F. H. Keeney is secretary and manager.

MARION, IND.—Plans are being made to enlarge and rebuild the municipal electric light plant. New equipment will be installed. The city is preparing to supply electricity for commercial purposes. Otis Weesner is superintendent.

MONTPELIER, IND.—The Montpelier Light & Water Company has been sued by the Citizens' Trust Company, of Ft. Wayne, asking foreclosure of a mortgage and payment of bonds of $38,000. The plant was built in 1900 and in 1905 there was a reorganization.

SOUTH BEND, IND.—The Indiana & Michigan Electric Company is making rapid progress in the construction of its dam in St. Joseph River at Berrien Springs and the repair of the Buchanan dam, and Oct. 1 is the time fixed to set in motion the various units entering into this electrical enterprise. Twenty-four of the 32 turbine water wheels have already been installed and the power house completed. The electrical machinery is beginning to arrive and will be installed by the time the dams are completed. The corporation is now furnishing electrical energy to the Southern Michigan Railway to operate the cars from South Bend, Ind., to St. Joseph, Mich. It also furnishes electricity for the Chicago, South Bend & Northern Indiana Railway Company's lines from Mishawaka to Goshen and between Laporte and Michigan City, and will also supply energy for the Murdock system from South Bend to Laporte as soon as the line is completed.

BURLINGTON, IA.—The People's Gas & Electric Company is in the market for water tube boilers of 1000 hp, also for coal and ash-handling apparatus. C. H. Walsh is purchasing agent.

CARROLL, IA.—The Carroll Light, Heat & Power Company is planning to extend its transmission lines from Carroll to Glidden to furnish electricity for lamps and motors.

RED OAK, IA.—Surveys are being made for the proposed electric railway of the Red Oak & Northeastern Railway Company from Red Oak to Des Moines, a distance of about 100 miles. Water power from the Raccoon and Nishnabotna Rivers will probably be utilized. M. N. Spencer, of Red Oak, is secretary.

REINBECK, IA.—A day service will be established by the local electric light plant. Peter Nissen is owner of the plant, and Charles C. Camp manager and lessee.

SHENANDOAH, IA.—The Artificial Ice, Power, Heat & Light Company proposes to extend its transmission lines to Farragut, a distance of six miles. John A. Masters is president and manager.

SIDNEY, IA.—It is reported that F. W. Schreiber is interested in the installation of an electric light plant.

SLOAN, IA.—Plans are being considered by the business men and residents of this city to install an electric lighting system in Sloan.

WATERLOO, IA.—The Citizens' Gas & Electric Company has submitted a proposition to the City Council offering to furnish 400 or more 50-watt tungsten lamps for $31.25 per lamp per year. If the city prefers to furnish the lamps the company will furnish electricity for the lamps for $25.25 per lamp per year, for all-night and every night service.

ALMA, KAN.—The Alma Light & Ice Company expects to install a 10-ton ice plant during the coming winter. W. B. Wilson is manager.

DODGE CITY, KAN.—The Midland Water, Light & Ice Company will install a 125-hp Buckeye gas engine and gas producer. George Theis, Jr., is president and manager.

EMPORIA, KAN.—The city is building a new municipal electric light plant and will install two new boilers, a new engine and generator. M. Dunsworth is manager.

ERIE, KAN.—The City Council has granted the Kansas Southern Electric Railway Company a franchise to build its electric railway through this city. F. V. Crouch, of Iola, Kan., is president.

OSKALOOSA, KAN.—The Oskaloosa Electric Light Company contemplates establishing a day service about Aug. 1. C. M. Buck is manager.

HALL, KY.—The Upper Rockhouse & Beaver Telephone Company is contemplating the construction of a telephone line from Puncheon to Jack's Creek, a distance of 16 miles.

LITTLE CYPRESS, KY.—An independent telephone company has been organized to install a local telephone system and will probably connect with the telephone lines of the Home Telephone Company, of Paducah, Ky. The officers of the company are: Dr. E. G. Goodloe, president; W. E. Hayden, vice-president; B. J. Storey, secretary and treasurer.

MORGANFIELD, KY.—The Morganfield Light & Power Company writes that it may possibly install a 100-kw, 550-volt, direct-current generator in its plant for power purposes. F. W. Gilbert is owner of the plant.

SERGEANT, KY.—The Letcher County Home Telephone Company contemplates installing a larger switchboard in its exchange and extending its telephone lines in different directions.

NEW ORLEANS, LA.—Daniel Schofield is planning to organize a company, with a capital stock of $250,000, to build a 15,000-spindle cotton mill, which will be operated by electricity.

ASHLAND, MAINE—C. A. Flint, owner and manager of the local electric light plant, contemplates changing from steam to water power and erecting seven miles of transmission line.

BRUNSWICK, MAINE.—It is reported that the Brunswick Electric Light & Power Company has purchased the power privileges of the Water Power & Pulp Company on the Androscoggin River in Brunswick.

ELLSWORTH, MAINE.—The Bar Harbor & Union River Power Company contemplates extending its transmission lines to Bar Harbor and Veazie. The line will be operated at 33,000 volts. L. H. Cushman is superintendent.

SOMERSET, ME.—Plans are being considered for the development of Ledge Fall, on the east branch of the Kennebec River, by A. C. Concannon and H. R. Lavenseller, of New York, N. Y., representatives of a New York syndicate. It is proposed to erect a dam to develop power and erect a pulp mill, the cost of which is estimated at $1,000,000.

SPRAGUE'S MILL, MAINE.—A movement is on foot to form a local company for the purpose of utilizing electrical energy from Aristook Falls for lamps and motors in this town.

BOONSBORO, MD.—The Burgess and Commissioners have awarded the contract for lighting the streets of Boonsboro for a term of 10 years to the Antietam Electric Light & Power Company for $700 per year. Electricity will be generated by water power, the plant to be located at the old Delemere Mill on the Antietam River, near Breathedsville.

HAGERSTOWN, MD.—The Hagerstown Street Railway Company contemplates building an electric railway from Hagerstown to Security, a distance of about two miles. W. C. Hepperlee is superintendent.

WILLIAMSPORT, MD.—The City Council has entered into a contract with the Hagerstown Railway Company to furnish electricity to light the city.

AYER, MASS.—The citizens have voted to authorize the Selectmen to make a contract for lighting the streets of the town by electricity or other illuminant for a term of not more than three years. If electricity is used the price is not to exceed $15 per lamp per year for incandescent lamps of 25 cp to burn until 1 o'clock on a moonlight schedule.

LAWRENCE, MASS.—Proposals will be received by the County Commissioners until Aug. 3 for the construction of central heating and electric lighting plant for the county training school at Lawrence. Bids will also be received at the same time for an electric elevator for the registry of deeds building at Salem.

LEICESTER, MASS.—The Selectmen have entered into a contract with the Worcester Electric Light Company to furnish electricity to light the streets of the town for a term of three years at the rate of

$18 per year per lamp for incandescent lamps. There is no reduction in the price of street lamps, but the lamps will be lighted from 6 o'clock p. m. until 6:30 a. m. from Nov. 15 until Feb. 15 each year. The company has agreed to reduce the price of electricity for commercial lighting from 20 cents to 15 cents per kw-hour.

MILFORD, MASS.—The Selectmen have entered into a contract with the Milford Light & Power Company for street lighting for one year. The company will furnish energy for 58 arc lamps of 1200 cp each at the rate of four cents per kw-hour, the lamps to burn every night until 12:30 o'clock and Saturday nights until 1 o'clock.

NORTH ATTLEBORO, MASS.—The Electric Light Department contemplates changing the street lighting system and installing constant-current transformers in the municipal electric light plant. William Plattner is manager.

QUINCY, MASS.—Owing to the increase in the demand for electricity at South Quincy, the Quincy Electric Light & Power Company has erected a substation in that section. Several granite companies have placed motors in their plants and others are planning to do so.

STOCKBRIDGE, MASS.—The contract between the town and the Stockbridge Lighting Company for lighting the streets of the town has been signed by the Selectmen. The contract is for a term of 20 years and provides for the use of not less than 80 of 60-cp lamps, for which the town is to pay $27 per year for each lamp served by the underground conduit system and $15 per year per lamp for service from overhead wires. The town has the privilege of operating its own lighting system if it chooses to do so by paying the company $6.50 for each lamp served from the conduit system, and $2.15 for each lamp served from the overhead wires for the unexpired portion of the contract.

WALTHAM, MASS.—Owing to the efforts of the special committee appointed by the Board of Aldermen to secure a reduction in the price of electricity, the Waltham Gas Light Company has announced a reduction in its rates from 17 to 16 cents per kw-hour.

CRYSTAL, MICH.—Otis A. Sanford, owner of the local electric light plant, has recently installed a new 85-hp boiler in his plant.

ELK RAPIDS, MICH.—The Elk Rapids Electric Company will extend its lighting service in the residence district. H. O. Joynt is manager.

GRAND LEDGE, MICH.—The City Council has asked the Commonwealth Power Company to make a proposition to furnish electricity to light the city. The company has about all the business its lines can carry, and if the company cannot furnish the city with energy, it will be necessary to expend from $10,000 to $15,000 on the municipal electric light plant.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Power Company has just completed the second 100,000-hp transmission line from the Croton Dam, a distance of 37 miles. The company has added many plants to its list of patrons during the last month and now furnishes electrical power for 600 motors in the city, furnishing electricity for motors operating ice-cream freezers and meat grinders to factory plants using 300 hp. The company furnishes 12,000 hp in this city alone for factory uses, and is also furnishing electrical energy for two interurban electric roads and part of the city lines.

HOLLAND, MICH.—A 500-kw steam turbine is being installed in the municipal electric light plant. James De Young is manager.

IRONWOOD, MICH.—The Twin City General Electric Company contemplates the construction of an extension to its system from Ironwood to Bessemer, Mich. E. D. Nelson is manager.

THREE RIVERS, MICH.—The Constantine Hydraulic Company contemplates extending its transmission lines to Sturgis, Mich. L. J. Botting is secretary and manager.

MANCHESTER, MICH.—The town is rebuilding the dam, plant and transmission lines of the municipal electric lighting system. L. R. Hatch is manager.

TRAVERSE CITY, MICH.—The Boardman River Electric Light & Power Company contemplates the construction of a new dam next spring. W. S. Cook is manager.

BOVEY, MINN.—Plans are being made by the Western Minnesota Power Company to extend its lines to Taconite and Holman, a distance of 2½ miles.

OLIVIA, MINN.—The rebuilding of the municipal electric light plant and pole line is being considered. J. F. Morgan is manager.

RUSHFORD, MINN.—Plans are being considered to string heavier wire and put in lightning arresters on the municipal electric lighting system. D. J. McCormick is superintendent.

THIEF RIVER FALLS, MINN.—The managers of the municipal electric light plant are planning to extend the street lighting service. Leonard Peterson is manager.

CLARKSDALE, MISS.—The City Council is considering extending the transmission lines of the municipal electric light plant to the Village of Lyons to furnish electricity to light the village.

KANSAS CITY, MO.—Plans are being made to change the motive power of the Missouri & Kansas Interurban Railway from steam power to electricity. The railway is 21 miles in length, and connects Kansas City with Olathe, Kan. The construction work will probably be done by the Arnold Construction Company, of Chicago, Ill.

MAITLAND, MO.—The Maitland Electric Light & Power Company expects to discard its Munzel gas engine and install a steam plant. A. O. Markt is manager.

SEDALIA, MO.—The Queen City Telephone Company has been reorganized and refinanced and is now practically controlled by the business men of Sedalia. A new switchboard has been purchased and other improvements are to be made to the system.

WEST PLAINS, MO.—The managers of the municipal electric light plant contemplates establishing a day service next year. W. P. Brittian is superintendent.

COOKE, MONT.—Arrangements are being made to install a power plant and saw mill at the falls on the Clark's Fork. H. W. Giles, Thomas Hamilton, Samuel Rayner, R. G. Reinsdorff and G. W. Hohlefop, all of Seattle, are interested in the enterprise.

GREAT FALLS, MONT.—Announcement has been made that John D. Ryan and associates will develop additional water power at Great Falls at a cost of $1,500,000.

MILES CITY, MONT.—George Burt is interested in a project to utilize the water power of the Yellowstone River to generate electricity to supply the towns and villages along the river.

FREMONT, NEB.—The Board of Public Works has awarded the contract for the alternating-current street lighting system to the Fort Wayne Electrical Works, Fort Wayne, Ind., for $3,658, an allowance being made of $1,628 for old apparatus.

STERLING, NEB.—J. Jerabek, of Sterling, writes that he has given up the proposition to install a lighting plant in Sterling, and states that there is a good opening for any one to install a lighting system in the town.

WAHOO, NEB.—Bids will be received at the office of L. H. Lyle, city clerk, until Aug. 4, as follows: Section 1, engine; Section 2, generator, exciter and switchboard; Section 3, series street lighting equipment and transformers; Section 4, line construction material; Section 5, poles. Bids will be received on one or any number of the sections. The cost of the work is estimated at $15,000. John Martz, of Seward, is engineer.

CARSON CITY, NEV.—The local substation of the Truckee River General Electrical Company was struck by lightning recently and put out of commission temporarily. Two large transformers at the plant of the Western Gypsum Company at Mound House were also destroyed during the storm.

FALLON, NEV.—Electricity generated by the water power of the Truckee-Carson irrigation project is being used to light Fallon, and it is planned to extend the transmission lines to Fairview and Wonder to furnish electricity in both towns. The water rights are held jointly by the government and a local corporation, which paid $75,000 for its privileges.

RENO, NEV.—The Nevada-California Electric Company has taken an option on the property of the Truckee River General Electric Company, which controls the Reno Light & Water Company and the Reno Traction Company, and will take over the property Aug. 1. F. G. Baum is president of the Nevada-California Electric Power Company.

LANCASTER, N. H.—The Lancaster & Jefferson Electric Company has increased its capital stock to $40,000.

EGG HARBOR, N. J.—The Atlantic County Electric Company will establish a day service about Oct. 1. Thomas T. Mather is superintendent.

MORRISTOWN, N. J.—The stockholders of the Public Service Corporation have voted to turn over its 900-year lease of the electric lighting plant and franchises in this city to the Morris & Somerset Electric Company, and the franchises in the towns of Mendham, Hanover, Chatham and Bernards.

ALAMORGODO, N. M.—Bids will be received by the Board of Trustees until Aug. 17 for the construction of a power house and steam heating plant for the New Mexico Institute for Blind at Alamogordo. R. H. Pierce is secretary.

ALBANY, N. Y.—The Champlain & Sanford Railroad Company has decided to operate its proposed railroad by electricity instead of steam power.

ALBANY, N. Y.—The Champlain & Sanford Railroad Company has agreed with the Public Service Commission of the Second District to operate its proposed railway with electricity instead of steam power. The company has applied for a charter to construct and operate a railway from Addison Junction to a junction with the Adirondack division of the Delaware & Hudson Railroad at Riverside, a distance of 58 miles.

AUBURN, N. Y.—The Auburn Light, Heat & Power Company contemplates placing several large contracts for furnishing electricity for motors which will require the erection of additional transmission lines. M. C. Curpin is superintendent.

BUFFALO, N. Y.—The Public Service Commission of the Second District has granted the Niagara Falls Electrical Transmission Company permission to transfer to the Buffalo, Lockport & Rochester Railway Company its private rights of way for its transmission line in the villages of Middleport, Medina, Albion, Brockport and Spencerport and the towns of Greece, Gales, Ogden and Ridgeway, which lay between Lockport and Rochester along the right of way of the railway company; also to assign and transfer to the railway company the municipal consents and franchises in the localities mentioned. The railway company is also authorized to use the transmission line owned by the Niagara Falls company from the South Greece station to the substation in Albion. The order provides that the Buffalo, Lockport & Rochester Railway Company shall not transmit

electricity over its transmission line for any purpose except for the operation of its railway without further application and consent of the commission.

DEPOSIT, N. Y.—Plans are being considered by the Deposit Electric Company to install a 250-hp engine. Morris Knapp is secretary and manager.

FAIRPORT, N. Y.—The Board of Village Trustees has called another special election to be held Aug. 10 to vote on the proposition of issuing $7,000 in bonds for improvements for the municipal electric light plant and water works system.

GARDENVILLE, N. Y.—The Buffalo Southern Railway Company is preparing plans for the completion of its system to East Aurora, a distance of about 20 miles. The cost of the extension with equipment is estimated at $500,000.

GLENS FALLS, N. Y.—The Kane's Falls Electric Company has applied to the Public Service Commission of the Second District for permission to construct a transmission line from Kane's Falls to the substation of the Hudson River Electric Company at Glens Falls.

KINGSTON, N. Y.—The Kingston Gas & Electric Company has applied to the Public Service Commission of the Second District for permission to issue $33,000 in bonds to take up $32,500 of the bonds of the Rondout & Kingston Gas Light Company.

LANCASTER, N. Y.—The Depew & Lancaster Light & Power Company contemplates the extension of its 2200 and 11,000-volt transmission lines. The company distributes Niagara power in Depew and Lancaster. H. B. Zimmerman is manager.

MORAVIA, N. Y.—The Moravia Electric Company is planning to change its primary voltage to 2200 before Jan. 1, 1909. Silas Taber is secretary and manager.

NEW PALTZ, N. Y.—The Electric Light Company, of New Paltz, has contracted with the Hudson Counties Gas & Electric Company for electrical energy to operate its system with a 24-hour service to take effect Oct. 1, 1908. The Electric Light Company of New Paltz will change its present system to 2300-volt, 60-cycle, two-phase. S. L. Johnston is treasurer and manager.

NEW YORK, N. Y.—Bids will be received at the depot quartermaster's office, 39 Whitehall Street, New York, N. Y., until Aug. 4, for furnishing 111,000 incandescent electric lamps for the quartermaster's department; also alternate proposals for furnishing 272,500 of these lamps to be furnished to the Treasury and Quartermaster's Departments, Library of Congress, and the State, War and Navy Building. Blanks for proposals, specifications and full information will be furnished upon application to the above office. Col. William S. Patten is depot quartermaster.

NIAGARA, N. Y.—The Niagara Falls Power Company has begun work on the extension of the transformer house of the Canadian Niagara Power Company across the river. The present output of the plant is 25,000 hp and it is proposed to increase the output to 32,500 hp. The power company is now constructing a transmission line to Buffalo. It is hoped to have the extensions completed and in operation by Oct. 1. Philip H. Barton is manager of the Niagara Falls Power Company.

ROCHESTER, N. Y.—The Rochester, Charlotte & Manitou Railroad was purchased July 21 by Kendall B. Castle at auction for $12,000. It is understood that the Mohawk Valley Company is interested in the purchase.

ROCHESTER, N. Y.—Proposals will be received at the office of the purchasing agent, court house, Rochester, until Aug. 10 for the installation of a refrigerating plant complete, operated by electricity, at the Monroe County Morgue. Plans and specifications can be seen at the office of Crandall & Stroebel, architects, Ellwanger & Barry Building, Rochester. Willis K. Gillette is secretary.

SYRACUSE, N. Y.—The contract for enlarging the power house at the Syracuse University, Syracuse, N. Y., has been awarded to the Consolidated Engineering & Construction Company, New York, N. Y. The cost of the work is estimated at approximately $50,000.

WAPPINGER FALLS, N. Y.—Plans are being considered to double the output of the municipal electric light plant and extend the transmission lines to New Hamburg, Hughesville, Lowpoint and Hackensack. J. L. Hughes is superintendent.

BREVARD, N. C.—The Brevard Light & Power Company contemplates increasing the equipment of its plant. J. W. Chapman is superintendent.

EAST DURHAM, N. C.—The Durham Cotton Manufacturing Company is planning to discard its steam power plant and install electric generators and motors to operate the machinery in its plant. The improvements will involve an expenditure of about $50,000.

HENDERSONVILLE, N. C.—The Hendersonville Electric Light & Power Company is planning to develop a second water power to be completed by next fall. W. H. Bangs is superintendent.

HICKORY, N. C.—Negotiations have about been completed for the development of Horseford Shoals, near Hickory. The plant will supply electricity to Hickory, Lenoir and other towns. Col. M. E. Thornton is interested in the project, and it is expected that work on the construction of the plant will begin in the near future.

RALEIGH, N. C.—The Raleigh Cotton Mills is making arrangements to install equipment to operate its mill by electricity. The mill has a capacity of 15,000 spindles. The Pilot Cotton Mill Company will also install electrical apparatus to operate its plant.

RALEIGH, N. C.—Negotiations have been completed between the Chamber of Commerce, Raleigh, N. C., and the promoters of the electrical development of Buckhorn Falls, near Fayetteville, N. C., whereby electrical energy will be transmitted for manufacturing purposes, several firms having signified their intention, it is stated, of contracting for electricity to operate their plants.

RALEIGH, N. C.—The name of the Central Carolina Power Company has been changed to the Carolina Light & Power Company, the capital stock increased from $1,000,000 to $3,750,000, and the office removed from Fayetteville, N. C., to Raleigh. The company is erecting a hydro-electric plant at Buckhorn Falls on Cape Fear River. James D. Mortimer, of New York, N. Y., is president of the company; Egbert Douglass is in charge at Raleigh.

SALISBURY, N. C.—H. W. Frund, manager of the Salisbury & Spencer Railway Company, writes that the company is installing the following machinery in its plant and expects to have it in operation within 30 days: One 300-kw synchronous motor generator set; one 450-hp synchronous motor, engine type, three-phase, 60-cycle, 2300-volt, 600 r.p.m., with shaft and bed plate; one 300-kw, 500-volt, direct-current generator; one direct current generator and five transformers; one six-panel marble switchboard complete; the company is also erecting a substation. Electrical energy for operating the system will be furnished by the Southern Power Company, of Charlotte, N. C., which already has its lines erected to the substation.

TARBORO, N. C.—A proposition has been submitted to the Town Commissioners by Dr. L. L. Station for the purchase of the municipal electric light plant, who proposes to furnish a day power service and supply electricity to operate the cotton mills.

TROY, N. C.—Plans are being made to build a dam across Little River about five miles from Troy and a hydro-electric plant to operate the Smitherman Cotton Mills. The plant will have an output of from 1000 to 2000 hp. The company plans to build another mill next year. S. J. Smitherman is president.

GRAND FORKS, N. D.—The City Council has granted a franchise to build a street railway system in Grand Forks. For further information address Mayor J. D. Taylor.

VALLEY CITY, N. D.—A special election will be held Aug. 18 to vote on the proposition to issue $18,000 in bonds to establish a municipal electric lighting plant.

CLEVELAND, OHIO.—The Cuyahoga Light Company has applied to Council at Lakewood for a franchise to furnish electricity for lighting the streets of the city. The company offers to furnish electrical energy for lamps at the rate of 4½ cents per kw-hour, which is a half cent under the Cleveland Electric Illuminating Company's rate. The maximum rate of the Cuyohoga company is to be 8 cents per kw-hour against 12½ cents of the Cleveland company. If granted a franchise and a contract to furnish electricity for street lamps the Cuyahoga will erect a separate plant in Lakewood.

CROOKSVILLE, OHIO.—It is reported that the plant of the Acme Electric Light & Power Company has been purchased by J. E. Horn, and that improvements will be made to the system.

FREMONT, OHIO.—The Fremont City Street Railway Company has made application to the City Council of Toledo for a franchise which will enable the company to extend its railway to the Lake Shore Station and to Spiegel Grove.

MARION, OHIO.—The Marion Railway, Light & Power Company is extending its lines in various parts of the city and arranging to do an increased business.

MIDDLETOWN, OHIO.—The Middletown Telephone Company will make extensions to its system in this city, which will involve an expenditure of about $50,000.

NEW LEXINGTON, OHIO.—The Perry County Telephone Company will make extensive improvements to its plant in this city, including the overhauling of its present lines and the erection of new lines. The cost of the work is estimated at $4,000.

WARREN, OHIO.—The City Council has granted franchises to both the Warren Water & Light Company and the Hydro-Electric Company for a term of 25 years to furnish light, heat and power in Warren, in return for which the city is to receive 1 per cent of the gross earnings of the companies.

BLISS, OKLA.—Plans are being considered by W. W. Lockwood, of Winfield, Kan., to install an electric plant to furnish electricity for lighting his ranch.

SALLISAW, OKLA.—The town officials have made arrangements with Messrs. London & Day, owners of the local electric light plant, whereby the plant is to be controlled by the municipality. The consideration was $10,500.

EUGENE, ORE.—S. W. Curtis, representing the Southern Pacific Company, has filed on water rights of Odel Lake, in the Cascade Township, about 100 miles from Eugene, appropriating 12,000 miners inches of water under a 6-in. pressure.

HEPPNER, ORE.—Harry W. Mangold has applied to the Commissioners of Morrow County for a franchise for the transmission of electricity in the County of Morrow. Mr. Mangold owns valuable water rights on the north fork of the John Day River, which he proposes to

develop to generate electrical energy for lamps, motors, etc. The transmission line will extend through Hardman, Heppner, Lexington, Ione and Irrigon.

KLAMATH FALLS, ORE.—The Midway Telephone & Telegraph Company will reconstruct its telephone line connecting Klamath Falls and Bonanza.

McMINNVILLE, ORE.—The McMinnville Local & Long Distance Telephone Company contemplates the construction of a telephone line to Portland where connections will be made with the Home Company.

CHRISTIANA, PA.—The Christiana Electric Light Company will install a 72 in. by 15 in. tubular boiler in its plant early in August, and is desirous of securing prices and specifications from boiler manufacturers. A. J. Melcher is manager.

CLEARFIELD, PA.—The Clearfield Light & Power Company contemplates changing its system next summer to two-phase, 60 cycles. John W. Wrigley is secretary and treasurer.

HUGHESVILLE, PA.—The People's Ideal Telephone Company has applied to the Borough Council for permission to construct and operate a telephone system in Hughesville.

LEECHBURG, PA.—The Pittsburg & Allegheny Valley Railway Company, the Guarantee Title & Trust Company, receivers, contemplates the construction of a new power house. H. A. Waddell is superintendent.

MT. AETNA, PA.—The Mt. Aetna & Bethel Telephone Company has erected a telephone line connecting Mt. Aetna and Myerstown and other nearby towns and will make other extensions.

NEWCASTLE, PA.—Plans have been completed for the merger of the independent telephone companies under the name of the Interstate Telephone Association with headquarters at Newcastle. The local companies at the following places will be consolidated: North Jackson, Ohio; Beaves, Ohio; New Bedford, Plaingrove, Slippery Rock, Harrisville, Mt. Air, Blacktown and New Wilmington, Pa. The capital stock of the consolidated company will be placed at $150,000.

PHILADELPHIA, PA.—Leeds & Northrup Company, of Philadelphia, has been awarded the contract for the installation of an electrical testing laboratory in the city hall, for $2,516.

TITUSVILLE, PA.—The plant and holdings of the Titusville Electric Light & Power Company has passed into the hands of John L. and J. C. McKinney. The price paid for the plant was approximately $75,000. A new company has been organized, of which R. E. Dickinson will be secretary and treasurer, and Fred Woodring will act as superintendent. The plant has been in the hands of a receiver and the new company has assumed the bonded indebtedness.

WILKES-BARRE, PA.—The contract for a motor generator set and stationary transformer equipment to be installed in the new Luzerne County court house has been awarded to E. F. Roth, of Wilkes-Barre, for $8,000. The above machinery and equipment to be made by the Westinghouse Electric & Manufacturing Company.

PROVIDENCE, R. I.—A new motor generator station will be erected by the Narragansett Electric Lighting Company on Dyer Street adjoining the present battery station. The structure will be 1½ stories high and contain four 1000-kw motor generator sets for converting alternator current into direct current. The company has placed a contract with the Westinghouse Electric & Manufacturing Company for a 3500-kw steam turbine capable of carrying 50 per cent overload for two hours and 25 per cent overload for 24 hours. The cost of the building and equipment will cost approximately $75,000.

PIERRE, S. D.—Plans are being made to install an electric lighting system at the Cheyenne River Indian Reservation to be operated by the power plant used for pumping water for the reservation. It is proposed to install incandescent electric lamps for lighting the streets.

SIOUX FALLS, S. D.—The contract for installing a 16 x 36-in. heavy-duty Twin City Corliss engine to be direct connected to a 160-kw alternating-current generator in the State Penitentiary at Sioux Falls, has been awarded by the State Board of Charities and Corrections of South Dakota to the Minneapolis Steel & Machinery Company, of Minneapolis, Minn.

CUREO, TEX.—W. M. Ratcliffe, of Brownsville, Tex., has purchased the dam across the Guadalupe River, and proposes to rebuild the electric plant recently destroyed by fire. Temporary equipment will be installed to furnish electricity for lamps and motors for the town.

McKINNEY, TEX.—The contract for improving the municipal electric light plant has been awarded by the City Council to the Graber Machine Company, of Dallas, Tex. The new equipment for the plant includes engines, dynamos, etc.

PARIS, TEX.—The Texas Union Traction Company is planning to construct an electric railway between Paris and Bogata, a distance of about 25 miles, and later to extend the railway in the same direction 25 miles further to connect with a steam railroad. The overhead trolley system will be used and the power station will be located at Paris. Preliminary surveys are being made, and as yet no contracts have been awarded. C. P. Moore, of Longfellow, Tex., is president of the company.

BOYKINS, VA.—Thomas Atkins, owner of the plant of the Boykins Light, Power, Ice & Milling Company, writes that he contemplates building an ice plant and mill.

GORDONSVILLE, VA.—The town is rebuilding the municipal electric light plant, including the construction of a new power house and installing entirely new equipment.

LYNCHBURG, VA.—Plans are being considered to construct an electric railway extension to Durand, a distance of one mile. R. J. Hughes is interested in the enterprise.

PULASKI, VA.—The citizens on July 10 voted to issue $70,000 in bonds for the installation of a hydro-electric plant to furnish electricity to light the town, and for improvements to the water works system. Plans for the construction of the plant are being prepared by Edgar Wiley, of Lynchburg, Va. They will call for one and possibly two 300-kw units composed of a pair of horizontal turbine wheels direct connected to a revolving-field alternator. The transmission line will be 15 miles in length and electricity will be transmitted at 23,000 volts.

CASHMERE, WASH.—The citizens have voted to issue $10,000 in bonds to establish municipal electric light and water systems.

SPOKANE, WASH.—Plans are being considered by the Spokane & Inland Empire Railroad Company for the construction of an electric railway to the Big Bend Wheat country west of Spokane, and also for the construction of a railway from Spokane to Miles, a distance of about 70 miles, and from Miles to Kettle Falls, a distance of between 50 and 60 miles. The company also contemplates extending its system from the eastern city limits of Spokane to the irrigated tracts at Opportunity and Vera in the valley.

TACOMA, WASH.—Bids will be received until Sept. 19 by H. J. McGregor, commissioner of public works, for a hydro-electric light and power plant. The bids must be accompanied with full plans, details and specifications of all classes of work.

VANCOUVER, WASH.—The franchise of the Washington Home Telephone Company has been purchased by H. J. Roake, who proposes to organize a new telephone company.

CHARLESTON, W. VA.—The Home Telephone Company is planning to enlarge its plant in this city and will build a new pole line carrying four copper circuits, to Clendenin, where connections will be made with the Parkersburg Independent Telephone Company.

MARTINSBURG, W. VA.—Work has commenced on the construction of the power plant at Dam No. 4 on the Potomac River, near Martinsburg, for the Martinsburg Power Company. The power house will be equipped with three 800-hp units; each unit will be operated by two 40-in. turbines. The 22,000-volt transmission line will be 16 miles in length. It is expected to have the plant in operation by Dec. 1. B. F. Groff, of Lancaster, Pa., is the engineer.

PIKE, W. VA.—The Finch Telephone Company has decided to erect a telephone line from Pike to League, also a branch line from Pike to Highland.

WHEELING, W. VA.—Bids will be received by Captain F. W. Altstaetter, until Aug. 26 for the construction of a power house at each of the dams Nos. 18, 19 and 26 on the Ohio River.

DURAND, WIS.—The Durand Light & Power Company has sold the equipment and telephone system of the company to Frank Pierce as trustee for a syndicate of local stockholders. The telephone plant will be improved and the service extended. The light and power company is making a special effort to place electrical motors for manufacturing purposes in the city.

GREEN BAY, WIS.—Bids will be received at the office of the supervising architect, Washington, D. C., until Aug. 18, for the installation of a conduit and wiring system in the U. S. post office and court house at Green Bay, Wis., in accordance with the plans and specifications, copies of which may be had at the above office or at the office of German & Lignell, Duluth, Minn., architects. James Knox Taylor is supervising architect.

HARTFORD, WIS.—The City Council has purchased the distributing system of L. Kissel & Sons for $5,000. The city recently voted to issue $27,000 in bonds for the construction of a municipal electric plant, and will proceed at once to install a power plant on the site recently purchased.

JEFFERSON, WIS.—The Jefferson Mutual Telephone Company will extend its telephone lines to Oakland; also to Fort Atkinson and Johnson Creek.

KENOSHA, WIS.—Proposals will be received by George W. Harrington, city clerk, until Sept. 8 for furnishing electricity for lighting the streets of the city for a term of five and for 10 years from Aug. 20, 1909, the contract to provide for 155 or more arc lamps of 2000 cp. Bids to be submitted for an all-night and also for a moonlight schedule.

PORT WASHINGTON, WIS.—Bids will be received by W. B. Krause, city clerk, until Aug. 25, for three 100-hp water tube boilers; one 100-hp and one 200-hp tandem compound condensing Corliss engines; one 75-kw and one 150-kw, three-phase, 60-cycle, 2300-volt generators; one three-panel switchboard; one 75-light arc transformer and regulator; one 60-hp induction motor with exciters, feed pumps, heaters, condensers, pipings, belting, boiler setting, etc. Also for construction of brick addition to power house and smokestack. Bids will be received for the whole or any part of the plant. Plans and specifications will be on file at the office of the city clerk, Port Washington, Wis.; 31 Vroman Building, Madison, Wis.; Builders' & Traders' Exchange, Milwaukee, Wis.; and at the office of F. W. Dodge Company, Monadnock Block, Chicago, Ill., after Aug. 11. W. G. Kirchoffer is engineer.

PRINCE WILLIAM, N. B., CAN.—Arrangements are being made by the New Brunswick Telephone Company to extend its telephone lines from Prince William to Harvey Station, via Dumfried.

STONY CREEK, ONT., CAN.—Camby Wismer, of Jordan, and Levi Moyer, of Beamsville, are interested in the organization of an independent telephone company.

TORONTO, ONT., CAN.—The capital stock of the Toronto Power Company has been increased from $100,000 to $1,000,000. The company will control the Electrical Development Company. The increase in capital stock is asked in connection with the financing of the power plant.

SPRINGSIDE, SASK., CAN.—The Yorkton, North West Telephone & Electric Light Company is planning to install and operate a telephone system in this city.

CHIHUAHUA, MEX.—The Compania Agricola y Colonizadora of Chihuahua is preparing to install a large hydro-electric plant on the Conchos River in the district of Camargo, state of Chihuahua. Electricity furnished by the plant will be used to operate the industries of the company and will also be transmitted to other towns of that section.

GUADALAJARA, MEX.—The Compania de Tranvias Luz y Fuerza de Guadalajara is preparing to install a large amount of new electrical machinery at its hydro-electric plant at Juanacatlan, near Guadalajara, in order that it may be able to meet the growing demand for electricity for motors.

MEXICO CITY, MEX.—Juan Alonzo has taken the preliminary steps to install a hydro-electric plant on the Molina de Calderon River in the state of Mexico.

MEXICO CITY, MEX.—A hydro-electric plant is to be established on the Escondido River in the state of Chihuahua by the Compania Carbonifera de Rio Escondida. The company will take the water from the river at La Fiesta and convey it through a canal about 9,000 ft. long to the site of the hydro-electric plant.

MEXICO CITY, MEX.—The Mexican Government is enlarging its water supply system for this city and is installing five large electric pumping stations at the source of the water supply at Xochimilco, one of which has been placed in operation. Electricity for operating the stations will be supplied by the Mexican Light & Power Company from its hydro-electric plant at Necaxa.

MEXICO CITY, MEX.—The construction of a large hydro-electric power enterprise in Mexico is being promoted by a syndicate of British capitalists who are heavy stockholders in the Kansas City, Mexico & Orient Railroad, which is being built through the Western part of this country. This syndicate, represented by A. M. Nelson, a civil and electrical engineer, of Chihuahua, Mexico, has made application to the Mexican Government for a concession for the project. It is planned to install the hydro-electric plant on the Fuerte River, in the state of Sinaloa. About 10,000 hp will be developed and transmitted to a number of mining camps, situated within a radius of 50 miles.

OCAMPO, MEX.—Gonzalo Carranza, of Mineral de Ocampo, state of Chihuahua, will install a hydro-electric plant on the Nevosiagame River for the purpose of supplying electricity for a number of mines in that section.

PUEBLA, MEX.—The Tramway, Light & Power Company, of Puebla, has acquired the holdings of the other electric companies operating in this city. The City Council, in approving the merger, stipulates that the overhead cables must be placed underground.

New Incorporations.

INVERNESS, FLA.—The Inverness Power Company has been incorporated, with a capital stock of $25,000, and the following officers: Baxter Morrison, president, and W. F. Warnock, secretary.

JASPER, FLA.—The Jasper Water & Light Company has been incorporated, with a capital stock of $25,000. The officers of the company are: W. A. Smith, president; C. W. Smith, vice-president; B. B. Blackwell, secretary and treasurer. The company will not make any changes at present, but may make improvements and install additional machinery late in the fall.

PALESTINE, ILL.—The La Motte Co-operative Telephone Company has been incorporated, with a capital stock of $2,250, by G. L. Wesner, J. G. Nelson, William J. Kirchey and others.

HILLSDALE, IND.—An independent telephone company has been formed to install a local system and the construction of a telephone line to Montezuma is also contemplated. The officers are: D. B. Highfill, president; John Taylor, secretary, and Samuel Hammersley, treasurer.

DABNEY, KY.—Articles of incorporation have been filed for the Dabney Telephone Company by W. H. Ownes, C. A. Bishop, W. H. Price and others. The company is capitalized at $2,000.

LAKE CHARLES, LA.—Articles of incorporation have been filed for the Lake Charles Railway & Light Company, with a capital stock of $75,000. The company was formed to take over the property of the Lake Charles Street Railway Company, and its charter privileges include the operation of electric light or other plants to furnish light, heat and power. The officers are: Thompson J. Bird, president; J. Alfred Laudey, vice-president, and Paul O. Moss, treasurer.

FRASER, MICH.—The Farmers' Telephone Company has been organized to install a local telephone system. The officers are: Charles Kalkman, president; S. R. Marks, secretary, and John Shue, treasurer.

MAHNOMEN, MINN.—The White Earth Telephone Company has been incorporated, with a capital stock of $10,000, by Charles H. Sanders, M. M. Sanders, Kathryne Sanders and L. G. Sanders.

RUSSELL, MINN.—The Russell Farmers' Mutual Telephone Company has been incorporated, with a capital stock of $10,000, and the following officers elected: A. J. Burckhardt, president, and W. C. Henrich, general manager.

CARSON CITY, NEV.—Articles of incorporation have been filed for the Western Pacific Telephone & Telegraph Company to install a telephone system in the counties of Modoc, Plumas and Lassen in Northern California. The incorporators are Janes G. Sweeney, T. F. Adams and Alfred Kange.

STARKWEATHER, N. D.—The Farmers' Telephone Company has been incorporated, with a capital stock of $24,000, by M. W. Revis, J. A. Haughtelin, P. C. Gering, J. F. Quick and A. J. O'Connor, all of Starkweather.

BEALLSVILLE, OHIO.—The Melott Ridge Telephone Company has been chartered, with a capital stock of $3,000, by A. W. Varner, C. F. McDowell, Charles Bolon, G. Pittman, R. M. Hobb and L. T. Melott.

YOUNGSTOWN, OHIO.—Articles of incorporation have been filed for the Mahoning Telephone Company, with a capital stock of $10,000. The company proposes to install a telephone system in this city.

FLORENCE, ORE.—The Coast Line Telephone Company has been chartered, with a capital stock of $2,500, by D. M. Kemp, C. H. Holden, C. E. Harwood and others. The company proposes to install and operate a telephone system in and about Florence.

ARMAGH, PA.—The Armagh Township Light, Heat & Power Company has been incorporated, with a capital stock of $5,000. The directors are: William P. Woods, of Lewiston, Pa., treasurer; Wallace Wilson, of Alexandria, Pa., and James S. Woods, of Huntington, Pa. The Brown Township Light, Heat & Power Company and the Derry Township Light, Heat & Power Company have been incorporated, each with a capital stock of $5,000 and the same directors as the Armagh Township Light, Heat & Power Company.

MONTREAL, QUE., CAN.—The Bermuda Companies, Ltd., has been incorporated under the Dominion Companies Act to construct and operate an electric railway in the colony of Bermuda. The capital stock is placed at $100,000, and the directors are: A. A. Allen, C. Morgan, C. G. Heward, E. G. T. Penny, of Montreal, and G. M. Allen, of New York, N. Y.

LUMSDEN, SASK., CAN.—The Lumsden Radial Telephone Company has filed articles of incorporation and proposes to install a local telephone system at Lumsden.

YELLOW GRASS, SASK., CAN.—The Yellow Grass Telephone Company has been incorporated and is planning to commence work on the construction of its system at an early date.

New Industrial Companies.

THE UNION ELECTRICAL MANUFACTURING COMPANY, of San Francisco, Cal., has been incorporated with a capital stock of $50,000 by A. A. Clue, L. G. Copeman, G. M. Fisk, P. A. Clifford and F. J. McNulty.

THE PACIFIC ELECTRIC COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000 and the following directors: Franklin Bein, Thomas Adam, M. Bischoff, all of New York, N. Y.

THE HUKLE GAS ENGINE & MANUFACTURING COMPANY, of Lexington, Ky., has been incorporated with a capital stock of $50,000. The officers of the company are: L. A. Ruckno, of Louisville, president; John F. Bean, of Lexington, secretary and treasurer.

THE AERIAL ELECTRICAL SWING COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $6,000, to manufacture and deal in circle swings, etc. The incorporators are: William J. Bullion, George Hamilton and Alexander Taylor, of Buffalo, N. Y.

THE GRANT ELECTRIC COMPANY, of St. Louis, Mo., has filed articles of incorporation, with a capital stock of $3,000. The object of the corporation is to manufacture and deal in electrical appliances. The incorporators are Adolph L. Zuest, Jr., Fred J. Mayer and Erie R. Jackson.

Company Elections.

NEW LONDON, CONN.—At the annual meeting of the Groton & Stonington Railway Company the following named officers were elected: Thomas Hamilton, president; B. F. Williams, vice-president; Charles D. Noyes, secretary; Contello Lippitt, treasurer.

CARTHAGE, MO.—At the annual meeting of the Carthage Electric Light & Power Company the following named officers were elected: J. E. Strickland, president; C. M. Rohr, vice-president; S. M. Strickland, secretary and treasurer.

BURLINGTON, VT.—At the annual meeting of the Burlington Light & Power Company the following directors were elected: M. W. Stroud, S. P. Curtis, F. E. Burgess, F. H. Parker and W. P. Murphy.

Personal.

PROF. H. T. EDDY has resigned as professor of electrical engineering of the University of Cincinnati.

MR. V. R. LANSINGH sailed for Europe on Saturday, July 25, to be gone six weeks. He will spend the greater part of his time in studying recent European developments in the science of illumination and in going over the situation there as regards holophane globes.

MR. W. H. BROWNE.—In last week's issue was published in this column an item about the appointment of Mr. W. H. Browne, of Brooklyn, N. Y., as general manager of the Rockingham Power Company, of Rockingham, Me. In the transition from writing to type the state "Me." was somehow evolved from N. C. Mr. Browne goes to Rockingham, N. C., not to Rockingham, Me.

MR. A. H. KIMBALL, for many years past connected with the Fitchburg, Mass., Gas & Electric Company as superintendent of its electrical department, has resigned the position of general manager of the Fall River Electric Light Company, of Fall River, Mass. The brilliant work of Mr. Kimball in the development of the motor and power business at Fitchburg is well known to our readers.

MR. R. B. BENJAMIN, president of the Benjamin Electric Manufacturing Company, Chicago, has gone to London, England, for the purpose of establishing a branch office and factory for manufacturing and handling its wireless clusters and lighting specialties abroad. He is accompanied by Mr. B. J. Grigsby, of the engineering department, who will be left in charge upon Mr. Benjamin's return.

MAJOR E. L. ZALINSKI, U. S. A., retired, has assumed the presidency of the Bureau of Illuminating Engineering, 437 Fifth Avenue, New York City. He has devoted a great number of years to military research, particularly that of artillery. Major Zalinski is perhaps best known in the lighting world by the results that have been obtained from the diffusing reflector which he perfected and brought out, and also through various articles which he has contributed on illuminating engineering. In these he paid particular attention to the diffusion of artificial light.

MR. WILL M. DIXON, who was chief of the Department of Electricity of the Jamestown Ter-centennial Exposition, and Mr. Howard F. Smith have formed a copartnership under the firm name of Dixon & Smith, engineers, and will conduct a general engineering business, with offices in the Wright Building, St. Louis, Mo. Mr. Dixon was connected with the electrical department of the Pan-American Exposition, and was electrical engineer of the Louisiana Purchase Exposition, at St. Louis. Mr. Smith was formerly with the New York Light & Power Company, New York, and was mechanical engineer of the Louisiana Purchase Exposition. Latterly he was associated with Mr. H. H. Humphrey, consulting engineer, of St. Louis. With their experience both gentlemen are well equipped to conduct the new business.

MR. W. E. GILMORE, who for several years past has been in active management and financial charge of Mr. Edison's manufacturing industries at Orange, N. J., has taken a year's leave of absence for rest and travel, and after that will not again give his whole time and attention to the business, having now private affairs that will fully occupy his time in the financial and industrial world. Mr. Gilmore began his Edison connection as stenographer to Mr. Samuel Insull at the Orange Laboratory and rose by sheer ability. He has been succeeded as president of the Edison Manufacturing Company by Mr. Frank L. Dyer, legal and patent counsel to Mr. Edison and a brother of Mr. R. N. Dyer. The general manager of the company will be Mr. Carl Wilson. Mr. Dyer will spend part of his time each week at the laboratory and part at the New York headquarters on Fifth Avenue.

MR. H. C. WILSON, superintendent of telegraphs for the government, Jamaica, West Indies, is now on a visit to the United States to look into the latest improvements and electrical developments. He is already well known in this country, having many friends in cable and other circles. He was born at March, Cambridgeshire, England, in 1854, and entered the telegraph service when only 12 years old, with the old Electrical & International Telegraph Company. He went to the Midland Railway in 1868 as telegraph clerk, and joined the submarine cable service in 1870, serving in Egypt until 1872. He joined the forces of the India Rubber & Gutta Percha Telegraph Works, going on the old *Dacia*, early in 1873, and was engaged in laying and picking up cables in the West Indies until 1874, when he went to Pernambuco for the Western & Brazilian Telegraph Company. He left the service at Bahia in 1877, and retired from the cable field to go to Jamaica, where he married. Fondness for his old profession led him to accept from the British government an offer to construct around the island of Jamaica its first system of telegraphs. This was started in 1879 and has been gradually extended with the addition of a limited telephone system. There are about 100 operators in 78 public offices working "open circuit" over about 1000 miles of wire. The system is unusually well conducted. During the earthquake Mr. Wilson was precipitated from the second floor of his house into the cellar and sustained severe injuries to one of his legs. Many of the staff were killed and the offices were destroyed, but Mr. Wilson with wonted energy has put the service back into good condition, in spite of the difficulty of securing funds adequate to the work. Mr. Wilson is a man of broad study and experience, and while here is familiarizing himself with the latest lighting and power developments. His health was greatly affected by the accident and by financial losses, but he has now thoroughly recuperated.

H. C. WILSON.

Obituary.

MR. C. H. DALE.—Charles H. Dale died at his summer home in Larchmont last week from heart disease, after a brief illness. He was 56 years old, and leaves a mother, widow and one daughter. Mr. Dale was president and director of the Peerless Rubber Manufacturing Company, the Mechanical Rubber Company, the Morgan & Wright Company, of Detroit; the New York Belting & Packing Company, the Rubber Goods Manufacturing Company, the American Commerce Company and the American Dunlap Tire Company, and a director in the Century Bank, the Fabric Fire Hose Company, the G. & I. Tire Company, of Indianapolis; the General Rubber Company, the Hartford Rubber Works, of Hartford; the Indiarubber Company of New Brunswick, N. J.; the Indianapolis Rubber Company, of Indianapolis; the Mechanical Fabric Company, of Providence; the Merchants' Exchange National Bank, the Single Tube Automobile & Bicycle Tire Company, and the Stoughton Rubber Company, of Boston. He was a member of the Union League, New York Yacht, Larchmont Yacht and New York Athletic clubs and the Automobile Club of America. Mr. Dale was widely known and highly popular in the mechanical field, and was one of the most prominent men in the American rubber industry.

Legal.

AJAX.—In the controversy waged since last fall between the George Cutter Company and the Ajax Line Material Company respecting the trade mark "Ajax," the Examiner of Interferences announces under date of July 10 that "it is adjudged that the Ajax Line Material Company is the owner of the trade mark and entitled to the registration."

Trade Publications.

ENCLOSED ARC LAMPS FOR FACTORIES.—The General Electric Company, Schenectady, N. Y., describes in a bulletin recently issued an arc lamp specially suited to the illumination of mills and factories, where the vibration caused by machinery and the variation in line voltage resulting from the use of motors for drive render the ordinary arc lamp unsatisfactory. The lamp described is of the multiple type and is for use on 220-volt, direct-current circuit. Special attention has been paid to the insulation of the binding posts and the hanger in order to avoid the grounding of the lamp as a result of the accumulation of dust on the top. This lamp is described in detail in Bulletin No. 4603.

SMALL GENERATING SETS.—Allis-Chalmers Company, Milwaukee, Wis., has issued a bulletin descriptive of its NI generator direct connected to an American Blower vertical engine. These are for small, reliable isolated plants. In the construction of the generator a perfect magnetic field circuit with accurately spaced pole pieces is attained by bolting the poles to the frame by countersunk filister head cap screws. The danger of the field becoming distorted when the pole pieces are cast into the frame, due to shrinkage and strains in the castings, while cooling, is eliminated. The vertical engine is guaranteed against defects and any parts will be replaced within one year without charge should they show any not due to misuse, abuse or neglect. The engine is also equipped with a patent oiling system which insures thorough lubrication at all times.

INSTRUCTIONS FOR RESUSCITATING PERSONS.—In view of the increasing use of electricity in Mexico, Messrs. G. & O. Braniff & Co., who are the general representatives in that country for the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., are distributing among their customers large, illustrated placards, upon which are printed Dr. A. H. Goelet's instructions for resuscitating persons who have suffered an electric shock. This is popularly known in its English form as the "Electrical World Resuscitation Chart." These placards are printed in Spanish and English and are intended to be placed in generating or substations, or wherever high voltage electricity is employed. A thorough understanding of these instructions and a careful observance at the time of accident may be the cause of saving many lives. Within the last few days a case has gone on record, at a mining property in Mexico, of a man having received a heavy charge from a 33,000-volt transmission circuit, being brought back to consciousness and ultimate recovery after more than two hours tireless application of these rules, which tends to confirm the belief that few cases of electric shock are necessarily fatal, unless the victim dies later from the effect of burns. These instruction cards Messrs. G. & O. Braniff & Co. will furnish upon application to parties in Mexico who are users of electricity.

Business Notes.

A TRANSFER TO CHICAGO.—C. S. Kiessling, who has been employed in the general offices of the American Steam Gauge & Valve Manufacturing Company for several years, has been transferred to their Chicago office and will have charge of the order department.

THE HERCULES ELECTRIC COMPANY, incorporated under the laws of Nevada, has been admitted to do business in Indiana. The company proposes to establish and equip a plant in Indianapolis, Ind., to manufacture all kinds of electrical supplies, machinery, etc. J. A. Kurtz is president.

THE HALLER SIGN WORKS (INC.), Chicago, have appointed Watlington & Co., Moorgate Station Chambers, London, E. C., their sales agent for Great Britain. This well-known firm will keep on hand a complete stock of electric sign letters, and can make immediate delivery of complete electric signs.

DOSSERT & COMPANY, of 242 West Forty-first Street, New York, have received orders from Westinghouse, Church, Kerr & Company for 115 special solderless elbow connectors, 300 and 600 amp sizes, to connect the station buses through oil switches to the 2400-vole outgoing lines at the Dutch Point station of the Hartford Light & Power Company, Hartford, Conn. These elbow connectors can be used to make joints at either right or left angles.

LORD ELECTRIC COMPANY, of 213 West Fortieth Street, New York City, has appointed as agents Mr. John S. Black, 223 Hennen Building, New Orleans, La.; Frank S. Harmar Co., 429 Mohawk Building, Portland, Ore. The Lord Company has already a large number of other agents all over this country and in other parts of the world. Its line of products has been very much enlarged, and its success is evidenced by the repeat orders and the increased demand.

INDEPENDENT CONTRACTORS.—The Independent Electrical Contractors' Association of Greater New York had their fourth annual outing July 11 at Seaside, Rockaway, L. I., when 350 members and guests participated. President C. A. Christensen made an address at the dinner. There were sports and dancing and an entertainment by W. E. Holbrook. Messrs. A. Newburger, F. W. Cohn, L. Freede, A. Whiteley and F. G. Schafer were the committee of arrangements.

THE GREGORY ELECTRIC COMPANY, of Chicago, reports considerable improvement in business, and states that it expects to do about its normal amount during the fall. In April and May the shipments were as large as at the booming period of 1907. The month of June and the early part of July showed a slight falling off, but orders are now coming rapidly, and the facilities of this company are taxed to take care of its very large stock and the drafts thereon in the shape of orders.

HOLOPHANE CONVENTION.—The fourth annual convention of sales, engineering and manufacturing departments of the Holophane Company was held at Hotel Sagamore, Lake George, July 12 to 18. The party consisted of some 40 salesmen, department heads and executive officers, in addition to whom were the wives of half a dozen of the men and several invited guests, making a party of over 50. Conferences on matters of business and policy occupied the mornings, the men engaging in sports and pleasure jaunts in the afternoons. A number of very important matters were discussed and plans adopted which will greatly enlarge the scope of the Holophane Company's work in future.

MESTA MACHINE COMPANY.—Owing to the increased demand for its product in the Central and Middle West, the Mesta Machine Company, of Pittsburg, has opened an office in Chicago at 844 Commercial National Bank Building, at which point the business in rolling mill machinery, gas and steam engines, condensers and machine molded gears, steel castings, etc., will be taken care of by Mr. Lane Johnson. Mr. Johnson, who for some time has been connected with the Pittsburg office of the company, is a graduate of the Massachusetts Institute of Technology, and for five or six years previous to accepting a position with the Mesta Company he was actively engaged in the iron and steel industry with the Colorado Fuel & Iron Company.

BASS FOUNDRY & MACHINE COMPANY.—Mr. J. W. Lowell, Eastern manager of the Fort Wayne Foundry & Machine Company, has also been appointed Eastern manager of the Bass Foundry & Machine Company, which has taken more commodious offices in the American Surety Building, 100 Broadway, New York. Mr. John H. Bass, of Fort Wayne, is president of both companies. By having combined the two offices under one management Mr. Lowell has been put in a position to handle contracts for steam engines and boilers or gas engines and gas producers. Prior to May 1 the offices of the Bass Foundry & Machine Company have been at 141 Broadway. The Bass Foundry & Machine Company was established in 1855 and has always maintained a New York office.

SQUEALING COMMUTATORS.—The squealing commutator is a source of much annoyance, even though it may be entirely free from sparking and arcing. The Joseph Dixon Crucible Company, of Jersey City, N. J., report that their graphite brushes, made in only one quality, are giving most excellent satisfaction. Their use results in the commutator taking on in a short time a highly polished surface, smooth and well rounded. They state that since the installation of their own electric plant some 8 years ago, they have not had occasion to turn down their commutators, and they attribute the condition of the commutator to the use of their graphite brush. A concise little booklet of 12 pages is supplied to any and all who may be interested in commutation and who will write for it. Some incidental hints given in this booklet include the testing of brush pressure and the filing of mica insulation. There are also some conclusions given as a result of tests made by Prof. Albert F. Ganz, of the Stevens Institute of Technology.

CHEMICAL FIRE EXTINGUISHER.—The "Success" portable fire extinguisher illustrated herewith is made of extra heavy Lake Superior cold rolled copper, securely riveted and reinforced by heavy shoulders of solder, every one of which is tested to withstand a pressure of 350 lb. to the square inch, or four times the required strength. The large wheel at the top of the machine is a convenience in opening and closing it, at the same time serving as a base on which to rest it when reversed, as in use for playing on a fire. The frame work, or bottle holder, containing the supply of sulphuric acid, is cast brass and virtually indestructible. The hose is tested to 400 lb. to the square inch. To put the apparatus in action it is only necessary to turn it upside down and the resultant mixture of sulphuric acid in the three gallons of water charged with bicarbonate of soda develops instantly force enough to throw a chemical stream 50 ft. This chemical stream acts as a blanket and smothers fire which water cannot reach. As the acid is neutralized, before it leaves the machine, the stream will not injure material with which it may come in contact. This extinguisher is included in the list of approved chemical extinguishers issued by the National Board of Fire Underwriters. It has recently been put on the market by the H. W. Johns-Manville Company, New York.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Association of Electric Motor Manufacturers. Secretary, J. C. McQuiston, Pittsburg, Pa. Next meeting, Thousand Islands, N. Y., Sept. 7.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City. Next meeting in September.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City, October, 1908.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont. Next meeting, Atlantic City, N. J., Oct. 12-16.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York.

American Society of Municipal Improvements. Secretary, A. Prescott Folwell, Room 512, Flatiron Building, New York. Next meeting at Atlantic City, N. J., October 13.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York. Next meeting, Atlantic City, N. J., Oct. 12-16.

Association of Edison Illuminating Companies. Assistant Secretary, S. E. Mumford, Detroit, Mich.

Association of Electrical Engineers of the Iron and Steel Industry. Secretary, G. H. Winslow, Frick Annex, Pittsburg, Pa.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary P. W. Drew, Room 511 Harvester Building, Chicago.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind. Next meeting, Sept. 24, 1908.

Chicago Electric Club. Secretary, S. M. McFedries, care J. L. Schureman & Co., Chicago.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, John F. Dostal, 405 17th St., Denver, Col. Next meeting, Glenwood Springs, Col., Sept. 16, 17 and 18.

ELECTRIC CLUB OF CLEVELAND. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 5.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting in October.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-second St., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., Aug. 19, 20 and 21, 1908.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ware, Grand Rapids, Mich.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia. Next meeting, Cedar Rapids, Ia., April 21 and 22, 1909.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting Cedar Rapids, Ia., April, 1909.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting at Pittsburg, Kan., October 8 and 9.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Grand Rapids, Aug. 18-21.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary-Treasurer, Ludwig Kemper, Albert Lea, Minn.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

MISSOURI ELECTRIC LIGHT, GAS & STREET RAILWAY ASSOCIATION. Secretary, C. L. Clary, Sikeston, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. W. Freeman, Brooklyn Edison Company, Brooklyn, N. Y. Headquarters, 33 West 39th St., New York.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred. P. Vose, 1343 Marquette Building, Chicago.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Aug. 25, 26 and 27, 1908.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, W. A. Rowe, Citizens' Building, Cleveland, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Galen Crow, Guthrie.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls, Sept. 16, 17 and 18.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, C. E. Russell, Boston, Mass. Monthly meetings, fourth Monday each month. Next annual meeting, fourth Monday in February, 1909.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JULY 21, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

893,606. MAGNETIC SEPARATOR; Charles G. Buchanan, Brooklyn, N. Y. App. filed April 5, 1906. Magnetic separator, having a drum with a series of circumferential grooves in which coils are contained. Results in the production of annular pole pieces, which revolve in proximity to the ore feed hopper.

893,612. TRACK INSTRUMENT FOR RAILWAY SIGNALS; John Francis Dineen, Geelong, Victoria, Aus. App. filed Aug. 8, 1906. A mechanical tappet for use with railroad signals, having a yielding rail support with a lever connection to a contact, so that when the rail is depressed by the weight of a locomotive the contact is closed.

893,618. ELECTRIC TRANSFORMER-FURNACE; Otto Frick, Stockholm, Sweden. App. filed Nov. 16, 1905. In an electric transformer-furnace having a masonry forming a melting space, and a cover rotatable relatively to the said masonry, substantially as and for the purpose set forth.

893,681. DYNAMO-ELECTRIC MACHINE; William L. Waters, Milwaukee, Wis. App. filed Dec. 13, 1906. The line of separation between the upper and lower parts of the casing of a dynamo-electric machine is on a zig-zag line, including two vertical and three horizontal planes.

893,688. ROTARY SNAP SWITCH; Herbert C. Williamson, New York, N. Y. App. filed May 18, 1906. A snap switch, having a positive ratchet and pawl action for locking and releasing the rotary parts upon a positive tensioning of a quick-acting make and break device.

893,711. FIELD MAGNET FOR DYNAMO ELECTRIC MACHINES; Abe L. Cushman, Concord, N. H. App. filed May 8, 1905. In order to assemble the field coils upon a magnet frame having enlarged pole faces, the patentee has the pole faces with a rearwardly

extending V-shaped projection which enters a corresponding recess of the frame.

893,730. RAILROAD SWITCH SIGNAL; William Henry Harris, Stark, Mont. App. filed Dec. 16, 1907. Means for notifying an incoming train whether or not a switch has been left open. Includes detail features of the circuit closer.

893,731. ELECTRIC SIGNAL FOR RAILWAYS; William Henry Harris, Stark, Mont. App. filed Jan. 6, 1908. A block signal system making use of sectional track rails electrified by a direct current and including signal lamps in the circuit, which are extinguished by the short circuiting of the rails by a passing train.

893,742. LIGHTNING ARRESTER; Ralph D. Mershon, New York, N. Y. App. filed Sept. 27, 1904. A system for protecting high potential lines from the destructive effects of lightning and static disturbances. Includes a plurality of spaced spark gaps along the ground wire, including ohmic resistances.

893,757. SWITCHING INDICATOR; Warren L. Sullivan, Newark, N. J. App. filed Oct. 3, 1907. A dispatching system to facilitate the switching of railway trains from a main track or section of a single track to any one of a number of branches leading from such section.

893,783. ELECTRIC HEATER FOR SHOE OPERATIVES' KNIVES; Edwin N. Chandler, Brockton, Mass. App. filed April 16, 1908. Provides a pair of flat metallic plates, which are separated by a small distance, to enclose a resistance element between them. The tool to be heated is clamped on the surface of the top plate. Has a switch for cutting out resistance elements as desired.

893,811. ELECTRICAL CONDENSER; Greenleaf Whittier Pickard, Amesbury, Mass. App. filed Nov. 5, 1907. A condenser, comprising a glass base and a paint thereon, consisting of mineral line and a finely powdered metallic conductor.

893,814. DEVICE FOR PRODUCING ELECTROLYTIC METAL PLATING; Albert Schmitz, Brussels, Belgium. App. filed March 12, 1906. Has a system of rollers and sliding conductors to establish contact with a wire movable through an electrolyte, so as to insure good electrical contact therewith.

893,816. STARTING DEVICE FOR MERCURY VAPOR APPARATUS; George Schwarz and Josef Amon, New York, N. Y. App. filed March 26, 1906. A means for starting mercury vapor lamps, including a branch circuit having a plunger and a heat coil to control the plunger.

893,820. INTERCOMMUNICATING TELEPHONES; Henry C. Thomson, Boston, Mass. App. filed March 20, 1907. Covers detail features of subscriber's box and circuits.

893,835. FIELD-MAGNET FOR DYNAMO-ELECTRIC MACHINES; Abe Lincoln Cushman, Concord, N. H. App. filed March 18, 1907. In order to permit assembling the field coils upon pole pieces having flaring faces, the patentee has poles made with outer hinge sections, which can be extended so as to permit the coils to slip over their ends.

893,857. FLEXIBLE CONDUIT; George A. Lutz, New York, N. Y., and Clarence C. Sibley, Perth Amboy, N. J. App. filed April 3, 1906. The conduit is constructed with a lining having a series of rows of perforations adapted to prevent the lining of the conduit being stripped out, as is sometimes done to enlarge a conduit to make wiring more convenient.

893,865. TELLTALE APPARATUS FOR RUNNING MACHINERY; Harry Ormiston Ormiston, Kogarah, and William David Martin, Ashfield, New South Wales, Aus. App. filed Aug. 10, 1907. The patentee has a small circuit closer arranged at the base of an electric generator and engaged by the armature thereof when the bearings become worn so as to give an indication of this fact.

893,873. INCANDESCENT LAMP SOCKET; William F. Ritter, Cincinnati, Ohio. App. filed May 13, 1907. Has a lining of fiber conforming to the interior surface of a socket shell and stamped of sheet material in such a way as to not only provide the necessary cup-shaped lining, but a partition between the circuit wires as well.

893,880. SWIVEL JOINT FOR ELECTRIC CURRENTS; Augustus B. Smith, Wilkinsburg, Pa. App. filed March 22, 1906. Makes use of a ball-bearing swivel joint through which the electrical connection is established.

893,891. HAND TELEPHONE SET; George F. Atwood, East Orange, N. J. App. filed March 12, 1906. In a hand telephone set, the combination with a hollow handle, of a transmitter and receiver carried by said handle, switch terminals within the handle, a plunger projecting through an opening in the handle adapted to control said terminals, and a flexible waterproof cover for said opening for rendering said opening watertight.

893,918. THERMOSTAT; William F. Gossick and Arthur R. van Valkenburgh, Chicago, Ill. App. filed July 18, 1907. Has a plunger spring impelled to close the circuit and normally restrained by a soldered connection. Has indicating means to show whether the wires of the system are unbroken in addition to the regular thermostat indications.

893,936. ELECTRIC REGULATION; Morris Moskowitz, New York, N. Y. App. filed April 2, 1906. Covers details of an arrangement for charging storage batteries at the same time that a lamp circuit of varying load is being supplied.

893,953. TELEPHONE RELAY; Charles W. Underwood, Crowley, La. App. filed Feb. 6, 1908. In a telephone relay, two telephone receiver magnets with their coils connected in series, a telephonic transmitter, an armature in operative relation to each telephone receiver magnet and mechanically connected to the transmitter element on the side thereof remote from the armature, and filamentary supports for each armature having a localized central connection thereto, and supports being under longitudinal stress.

893,979. DYNAMO-ELECTRIC MACHINE; James Burke, Erie, Pa. App. filed Feb. 4, 1907. The combination of a winding having a commutator, a multipolar field magnet having consecutive poles of alternate polarity, and a dynamo-electric generating winding connected to a point of varying potential in said first-named winding, said second winding having substantially one-half the conductors per circuit of said first-named winding.

893,993. SIGNALING MECHANISM; Willard H. Gilman, Medford, Mass. App. filed April 25, 1907. A signal transmitting apparatus, comprising a motor-operated contact device and electromagnetic means for first gradually checking the motor mechanism and thereupon positively stopping it.

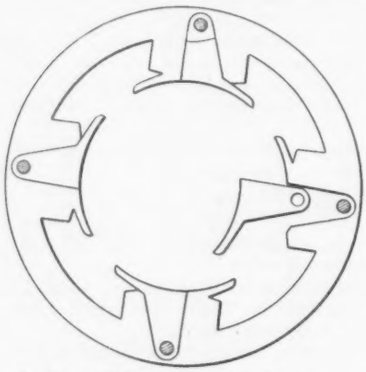
893,994. ILLUMINATED ELECTRIC HEATER; Francis C. Green, New York, N. Y. App. filed Nov. 30, 1907. A heater having an ornamental casing, including spiral porcelain tubes with resistance coils and a bank of lamps to give an ornamental effect.

893,997. DISTURBANCE-OPERATED CIRCUIT-BREAKER; Leo David Haas and Edwin George Derbidge, San Jose, Cal. App. filed Nov. 3, 1906. The patentee has a depending pendulum which maintains the circuit open while stationary. Any oscillation of the pendulum will, however, close an alarm circuit.

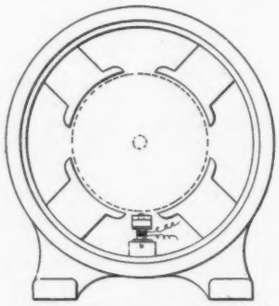
894,015. GENERATOR; Keijiro Kishi and Matsutaro Nakamura, Tokyo, Japan. Has means for securing the poles of a rotary field in place, whereby formed coil windings may be used and subsequently locked in place by the enlarged pole faces. Has a built-up pole, the parts of which are locked together by the system of keys.

894,044. ELECTRIC SELECTIVE SYSTEM; Frank D. Pearne, Chicago, Ill. App. filed July 11, 1904. Printing telegraph system, including various detail features.

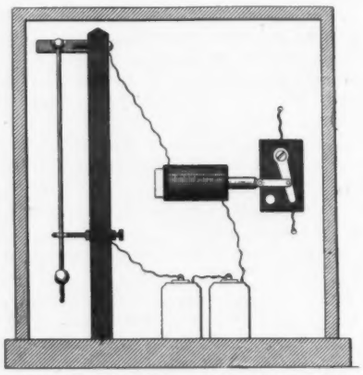
894,070. EXTRACTION OF WATER OR OTHER LIQUID FROM MINERAL, VEGETABLE AND ANIMAL SUBSTANCES; Botho Schwerin, of Höchst-on-the-Main, Germany. App. filed June 27, 1905. Has a pair of continuously moving belts, between which the water is flowed and which are made the electrodes of a circuit, whereby the water is electrolytically treated without any frictional movement against the electrodes.



893,835.—Field Magnet for Dynamo-Electric Machines.



893,865.—Telltale Apparatus for Running Machinery.



893,997.—Disturbance Operated Circuit Breaker.

894,142. TELEGRAPH TRANSMITTING INSTRUMENT; Frederick Herbert William Higgins, London, Eng. App. filed Dec. 12, 1905. A telegraph transmitter for type-printing instruments, designed to avoid the present difficulty of requiring a predetermined interval between the depressions of the successive keys.

894,144. ROTOR FOR DYNAMOS AND ELECTROMOTORS; Jack Hissink, Berlin, Germany. App. filed May 17, 1906. Has groups of rotor conductors projecting from the ends of the rotor core, and separating rings radially projecting beyond said conductors, and bonding wires wound on the conductors between the projecting rims of the rings.

894,150. LIGHTNING ARRESTERS FOR ELECTRICAL CIRCUITS; Ralph B. Ingram, Wilkinsburg, Pa. App. filed Dec. 4, 1905. Protective means for high potential distribution systems, making use of a series of spark gaps in the ground connection, which are connected to ground through reactances of continually varying magnitude in a uniform sequence.

894,157. PROCESS FOR OPERATING ELECTRIC ARC LAMPS IN SERIES; Frank M. Lewis, Brighton, Eng. App. filed Jan. 20, 1908. The process of operating a group of arc lamps in series, which consists in impressing a constant potential on the circuit and causing the arc length of each of the lamps in series to vary in unison from moment to moment to thereby gradually charge the current flow, substantially as described.

894,165. TELAUTOGRAPH; Foster Ritchie, Acton, Eng. App. filed April 27, 1908. Has means for dispensing with the use of batteries, whereby a telautograph may be operated from any available current supply, whether direct or alternating. Makes use of an electric generator, the brushes of which are oscillated by the movements of the telautograph.

894,166. MEANS FOR PRODUCING AND UTILIZING RAYS OF LIGHT FOR THERAPEUTIC PURPOSES; Corydon E. Rogers, Seattle, Wash. App. filed March 7, 1905. A therapeutic device, including a hood with an incandescent lamp having its rays directed through the bottom of the hood. Has a reflector with annular corrugation surrounding the lamp, whereby the reflector and hood constitute a continuous reflecting surface.

894,170. TELEPHONE REPEATER SYSTEM; Nathaniel G. Warth, Columbus, Ohio. App. filed April 22, 1907. In a relay for telephone lines, two induction coils, two transmitting devices, magnetically-controlled means operatively connected therewith, and two independent electromagnetic means included in closed local circuits solely with the secondaries of said induction coils.